Wake Forest Board of Commissioners Work Session
Meeting Agenda
March 01, 2022 at 6:00 PM

1. Presentations

1.1. Consideration of waiving the Renaissance Centre rental fees for the Launch Wake Forest May 31, 2022, class graduation.
Cognito Form Request 1.20.2022.pdf

1.2. Presentation of LEGISTLATIVE ITEM TA-22-01 Text Amendment to the Unified Development Ordinance
TA-22-01 Summary
TA-22-01 Staff Report
Attachment A: Application
Attachment B: Proposed Changes
Attachment C: Plan Consistency Analysis
Attachment D: Planning Board Recommendation
Exhibit 1: UDO Chapter 2
Exhibit 2: UDO Chapter 7
Exhibit 3: UDO Chapter 9
Exhibit 4: UDO Chapter 15
Exhibit 5: UDO Appendix B (MSSD)

2. Discussion of Monthly Financial Report

3. Review of Draft Agenda for Upcoming Regular Meeting

3.1. Review of Draft Agenda for Upcoming Regular Meeting
DraftBOCAgenda2022Mar15_Public.pdf

4. Other Business

5. Commissioner Reports

6. Adjournment

Board of Commissioners Work Session Agenda Item Report

Agenda Item No.: 2021-506-
Submitted by: Deborah Dunn
Submitting Department: Administration
Meeting Date: March 1, 2022

SUBJECT
Consideration of waiving the Renaissance Centre rental fees for the Launch Wake Forest May 31, 2022, class graduation.

Recommendation:

Item Summary:

ATTACHMENTS
- Cognito Form Request 1.20.2022.pdf

Status: **Read** Status: **Submitted**

Entry #: 6

Date Submitted: 1/20/2022 9:02 PM

Completing this form does not guarantee the requested event date. Deposits are required to secrure a date.

Pre-payments will not be accepted nor will dates be held.

Event Organizer Contact Information

Name
Brad Walker

Email
brad@infiniedge.com

Phone
(919) 745-0377

Organization Information

Organization Name
LaunchWakeForest

Is your organization a nonprofit?
Yes

Address
721 Old Dairy Drive, Wake Forest, North Carolina 27587

Website
https://launchwakeforest.com

Phone
(919) 745-0377

Proof of EIN number

Event Information

Event Name
LaunchWakeForest Graduation

Which facility are you requesting?
Renaissance Centre

Event Description
Annual Graduation event for the LaunchWakeForest Class of 2022.

Is your organization requesting a rental fee waiver?
Yes

Why are you requesting a rental fee waiver?
The Town of Wake Forest is part of the group that organizes the LaunchWakeForest.

What benefits or funding are you currently receiving from the Town?
Economic Development and educating business owners from Wake Forest.

What value does this event bring to the arts community?
We have trained several business owners that have art-type businesses.

Has your organization had any rental fees waived at any Town facility in the past 12 months?
No

Proposed Event Date
5/31/2022

Setup Start Time
5:00 PM

Event Start Time
6:00 PM

Event End Time
5/31/2022

Event Breakdown
9:00 PM

Estimated Attendance
75

Will tickets be sold to this event?
No

Is this a fundraiser for your organization?
No

Are there any other fees (participant, admission fees, booth rentals, etc.) associated with this rental?
No

Will the event include any of the following?
Catering

Signature

Date signed
1/20/2022

Internal Use Only

RC Decision
Approved

RC Comments
This event has taken place annually for several years and the rent has been waived in the past.

Room set-up fee
100

Cleaning fee
200

Damage Deposit
250

Rental Fee
400

Additional Hour Fee

Facility Rental Impact
950.00

Number of Part-time staff required
3

Number of Full-time staff required
1

Number of Off-Duty Officers required
0

Dollar Amount of Staff Labor Required
1,000

Total Cost Impact
1,950.00

RC Staff Signature

BOC Meeting Date

Town Clerk's Office Comments

TCO Staff Signature

Board of Commissioners Work Session Agenda Item Report

Agenda Item No.: 2021-483-
Submitted by: Dylan Bruchhaus
Submitting Department: Planning
Meeting Date: March 1, 2022

SUBJECT
Presentation of LEGISTLATIVE ITEM TA-22-01 Text Amendment to the Unified Development Ordinance

Recommendation:

Item Summary:

ATTACHMENTS

- TA-22-01 Summary
- TA-22-01 Staff Report
- Attachment A: Application
- Attachment B: Proposed Changes
- Attachment C: Plan Consistency Analysis
- Attachment D: Planning Board Recommendation
- Exhibit 1: UDO Chapter 2
- Exhibit 2: UDO Chapter 7
- Exhibit 3: UDO Chapter 9
- Exhibit 4: UDO Chapter 15
- Exhibit 5: UDO Appendix B (MSSD)

Agenda Item: Presentation of LEGISLATIVE ITEM TA-22-01 Text Amendment to the Unified Development Ordinance

Summary: A public comment session was held at the January 31, 2022, Planning Board meeting. The Planning Board voted 6-1 to find the request consistent with the Comprehensive Plan and recommend approval of the text amendment request with a condition to strike the following text from Section 9.5.5.A of the UDO–(e.g., structure could be wrapped by retail, office or some other active use along the primary façade)

Attachments: TA-22-01 Staff Report
Attachment A: Application
Attachment B: Proposed Changes
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Staff Report
TA-22-01: Unified Development Ordinance Text Amendment

Meeting Date	March 1, 2022
Requested Actions	Consideration of the following items related to a Unified Development Ordinance (UDO) Text Amendment: 1. Plan Consistency Statement. 2. Amendment to Chapters 2, 7, 9, 15, and Appendix B of the UDO.
Case Manager	Dylan Bruchhaus, Planner II
Planning Board Recommendation	The Planning Board voted 6-1 to find the request consistent with the Comprehensive Plan and recommend approval of the text amendment request with a condition to strike the following text from Section 9.5.5.A of the UDO– (e.g., structure could be wrapped by retail, office or some other active use along the primary façade).

PUBLIC MEETINGS

Public Comment Session	Public Hearing
January 31, 2022	March 15, 2022

CASE INFORMATION

Applicant	Town of Wake Forest 301 S Brooks Street Wake Forest, NC 27587
See Attachment A for copy of the Application.	

CASE SUMMARY

The UDO was adopted on July 16, 2013, and has been amended since by Town Planning staff. The UDO is a consolidated document which contains all the Town's regulations for zoning, development, subdivision, flood damage prevention, erosion and sedimentation control and storm water and is used during the development review process.

PROPOSED CHANGES

Chapter	Section
Chapter 2	Section 2.3.3 Use Table
Chapter 7	Section 7.5.5 Minimum Amenities Within Parks
Chapter 9	Section 9.4.2 Exemptions, Exceptions, & Adjustments Section 9.5 Vehicle Parking Design Standards - 9.5.2 Off-Street Parking Design Standards (New Section) - 9.5.3 Surfacing Materials (Former Section 9.5.2) - 9.5.4 Connectivity (Former Section 9.5.3) - 9.5.5 Structure Parking (Former Section 9.5.4) Section 9.6 Bicycle Parking Standards - 9.6.1 General Provisions (New Section) - 9.6.2 Short-Term Bicycle Parking (New Section) - 9.6.3 Long-Term Bicycle Parking (New Section) - 9.6.4 Bicycle Parking Design Standards (Former Section 9.6.1 and 9.6.2)
Chapter 15	Section 15.3.1 Sunshine List Section 15.17 Comprehensive Plan Amendment - 15.17.2 Review by the Planning Board - 15.17.4 Consideration by Board of Commissioners
Appendix B - MSSD	Entire document, references, and attachments.
See Attachment B for detailed Proposed Changes.	

COMPREHENSIVE PLAN CONSISTENCY

Community Plan (2009)	The proposed request is generally consistent with the Community Plan.
Comprehensive Transportation Plan (2019)	The Comprehensive Transportation Plan is not applicable to the request.
Historic Preservation Plan (2012)	The Historic Preservation Plan is not applicable to the request.

Northeast Community Plan (2021)	The Northeast Community Plan is not applicable to the request.
Parks, Recreation, and Cultural Resources Master Plan (2015)	The Parks, Recreation, and Cultural Resources Master Plan is not applicable to the request.
Public Art Vision Plan (2009)	The Public Art Vision Plan is not applicable to the request.
Renaissance Plan (2017)	The Renaissance Plan is not applicable to the request.
See Attachment C for detailed Plan Consistency Analysis and each adopted Plan for full policy guidance.	

STAFF RECOMMENDATION

Staff recommends approval of the proposed amendments to the Unified Development Ordinance. The request is generally **Consistent** with the relevant policies in the Comprehensive Plan, and **Approval** of the text amendment request is reasonable and in the public interest.

ATTACHMENTS

Attachment A: Application
Attachment B: Proposed Changes
Attachment C: Plan Consistency Analysis
Attachment D: Planning Board Recommendation

EXHIBITS

Exhibit 1: UDO Chapter 2
Exhibit 2: UDO Chapter 7
Exhibit 3: UDO Chapter 9
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UDO Amendment

idtPlans LLC
P.O. Box 13086 | Tucson, AZ 85732
P: (520) 319-0988 | F: (520) 319-1430 | E: info@idtplans.com

Project Overview #688060

Project Title: UDO Text Amendment - Chapter 2, 7, 9, 15, & Appendix B

Application Type: UDO Amendment

Workflow: UDO Amendment

Jurisdiction: Town of Wake Forest (Wake County)

State: NC

County: Wake

Checklist - Comprehensive Plan & UDO Amendment

A submittal checklist is available to view additional documents which are required to submitted with this application. After answering the application questions, you will be asked to upload the required documents.

VIEW COMPREHENSIVE PLAN & UDO AMENDMENT SUBMITTAL CHECKLIST

Missing items will result in the application being declined and returned to the applicant to resubmit. A revised and complete application including all missing items must be received or the application will be not be deemed complete and routed for review.

Please confirm you have reviewed the associated submitted checklist for this permit and confirm you will submit all documents required on the submittal checklist: Yes

Pre-Application Meeting

Has a pre-application conference been held?: Yes

This type of project requires a pre-application conference be completed prior to official submittal. Please return to the home screen and select **Pre-Application Conference** from the application type drop down list in order to schedule your required meeting.

Pre-Application Conference Date and Time: 10/13/2021 5:00 PM

Staff Member Met With: Planning Department

Project Tracking ID: TA-22-01

Project Contact - Applicant

Please enter all project contacts related to your application.

This is an important step to ensure all members of the applicant team receive email notifications associated with the project which may include comments, requested revisions, scheduled meetings or hearings, and final decisions. This also informs Town staff of the team members assigned role with the project.

Project Contact - Applicant

Dylan Bruchhaus
Town of Wake Forest

401 Elm Avenue
Wake Forest, NC 27587
P:(919) 5546100
dbruchhaus@wakeforestnc.gov

UDO Text Amendment

Description of Request:
Text amendment for Chapters 2, 7, 9, 15, and Appendix B of the UDO.

Justification of Amendments:
Provide clarity during the development review process and correct a staff oversight in Chapter 15.

Applicant Proposed Language:
Text amendment for Chapters 2, 7, 9, 15, and Appendix B of the UDO.

UDO Section	Section Title	Staff Comment
1. Text proposed to be added to the UDO are shown with red, underlined text. 2. Text proposed to be removed from the UDO are shown with red, strikethrough text.		
2.3.3	**Use Table**	**1. The proposed text amendment adds Indoor Recreational Facilities as a permitted use in the Light Industrial (LI) zoning district.** The Planning Department has received inquiries regarding allowing Recreation Facility, Indoor, as an allowable use in the Light Industrial (LI) zoning district. The use is defined in Section 17.3 as "Recreation Facilities, Indoor: Uses or structures for active recreation including gymnasiums, natatoriums, fitness center, athletic equipment, indoor running tracks, climbing facilities, court facilities and their customary accessory uses. This definition is inclusive of both non-profit and for-profit operations". Staff believes that this type of use is acceptable in the Light Industrial zoning district. A review of use tables by other Wake County municipalities was conducted by staff and found that the indoor recreation facilities use is a use that is allowed by other municipalities. This change would allow for the Town of Wake Forest to be more competitive with attracting indoor recreation businesses.

E. CIVIC	OS	RD	GR3	GR5	GR10	NB	HB	ICD	LI	HI	UR	RMX	RA-HC	NMX	UMX	PUD
Cemetery	Ps	Ps	Ps	Ps	Ps	Ps	Ps	Ps	–	–	Ps	Ps	Ps	Ps	Ps	–
Civic Meeting Facility	–	P	–	–	–	P	P	P	–	–	P	P	P	P	P	P
Community or Cultural Facility	P	P	P	P	P	P	P	P	–	–	P	P	P	P	P	P
Conference/Convention Center	–	P	–	–	–	–	P	P	–	–	–	–	–	–	P	P
Public Safety Station	–	SUP	SUP	SUP	SUP	P	P	P	P	P	P	P	P	P	P	P
Recreation Facility, Indoor	P	P	P	P	P	P	P	P	P–	–	P	P	P	P	P	P
Recreation Facility, Outdoor	P	P	P	P	P	P	P	P	–	–	P	P	P	P	P	P
Religious Institution	–	Ps	Ps	Ps	Ps	Ps	Ps	Ps	–	–	Ps	Ps	–	Ps	Ps	–
Sports Arena/Stadium	–	–	–	–	–	–	SUP	SUP	P	–	–	–	–	–	SUP	SUP

7.5.5	**Minimum Amenities Within Parks**	**2. The proposed text amendment will change the classification of bicycle facilities to short and long term, rather than a class system. This change brings the section in line with the new classification system which replaces class III as short-term bicycle parking and classes I and II as long-term bicycle parking. Refer to Section 9.6 below for more details on the proposed change.**

A. Minimum Amenities (All Neighborhood Park Types):

1. Public Seating: Provide seating areas appropriate to the intended use of the space (e.g., park benches and durable theft/vandalism-resistant chairs in formal/active spaces and garden wall seats in informal/passive spaces).
2. Supplement Tree Planting/Significant Species Preservation: A minimum of 1 tree (2 inch caliper minimum measured 6" above the ground at installation) to be planted in at least 350 square feet of soil or 1 preserved existing canopy tree a minimum of 12" caliper for every 2,500 square feet of required park space.
3. Trash Receptacle: Garbage receptacles and recycling receptacles shall be required for each park space.

UDO Section	Section Title	Staff Comment
4. Bicycle Parking: At least 4 ~~Class III~~short-term bicycle parking spaces shall be required for every one-quarter acre of neighborhood park space and every ½ mile of greenway. Bicycle parking shall be designed according to the bicycle parking standards in Section 9.6.		
9.4.2	**Exemptions, Exceptions, & Adjustments**	**3. The proposed text amendment will change the classification of bicycle facilities to short and long term, rather than a class or tiered system. This change brings the section in line with the new classification system which replaces class III as short-term bicycle parking and classes I and II as long-term bicycle parking. Refer to Section 9.6 below for more details on the proposed change.**
B. Exceptions for Non-Residential Uses in the Renaissance Area: Nonresidential uses, located outside of the RA-HC district, in the Renaissance Area of downtown (as defined by the Renaissance Plan for Downtown Wake Forest, NC, dated September 2017, and as amended), may reduce the required off-street, automobile parking spaces, required in this Chapter, by up to 50% with Administrator approved provided the following are met: 1. The remaining number of required off-street parking spaces must be provided on-site, within a shared parking area (Section 9.4.3), a satellite parking area (Section 9.4.4), or by adjacent on-street parking (Section 9.4.2.D); 2. If a mixed-use development is proposed, the total number of required residential spaces must be provided; and 3. Additional bicycle parking, over and above what is required by Section 9.4.A, is required. A minimum increase of 50%~~, but not less than two (2) Type I or Type II~~ long-term bicycle spaces shall be provided.		
9.5.2 (new section)	**Off-Street Parking Area Design Standards**	**4. The proposed text amendment creates a new section adding design standards to off-street parking areas. These standards impact pavement markings in driveways, drive aisles, and parking bays.**
9.5.2 Off-Street Parking Area Design Standards A. Pavement directional arrows shall be provided on one-way driveways, one-way drive aisles, drive aisles with angled parking, and locations warranted by the Administrator for safety and traffic operations. B. Loading areas and off-street parking spaces shall be marked with pavement surface markings so that they are easily identified. C. Stop bars, directional arrows, crosswalks, and any regulatory pavement markings required by MUTCD standards shall be marked with white thermoplastic.		
9.5.3 (former 9.5.2)	**Surfacing Materials**	**5. The change adds materials to the title of the section to distinguish the surfacing standards from the other design standards. This numbering for this section is changing from 9.5.2. to 9.5.3 with the inclusion of the new section for Off-Street Parking Area Design Standards.**
9.5.3 Surfacing Materials		
9.5.4 (former	**Connectivity**	**6. This numbering for this section is changing from 9.5.3. to 9.5.4 with the inclusion of the new section for Off-Street Parking Area Design**

UDO Section	Section Title	Staff Comment
9.5.3)		**Standards.**
9.5.5 (former 9.5.4)	**Structured Parking**	**7. The change strengthens screening requirements for parking structures by requiring the entire side facing a street to be screened rather than just the first floor. This numbering for this section is changing from 9.5.4. to 9.5.5 with the inclusion of the new section for Off-Street Parking Area Design Standards.** During the Planning Board presentation, the Planning Board recommended striking (e.g., structure could be wrapped by retail, office or some other active use along the primary façade) from Section 9.5.5.A of the UDO. Section 9.5.5.B describes screening material requirements and that the parking deck façade shall visually screen cars. The change does not prevent ground floor retail to wrap a parking deck as screening, but increases clarity that screening can be accomplished by materials along the façade of the deck.

9.5.5 Structured Parking

A. Screening Required: Where an above-ground parking structure fronts a public street, the ~~ground level~~ side(s) facing the street shall be screened in such a way that cars are not visible from the street. ~~(e.g., structure could be wrapped by retail, office or some other active use along the primary façade).~~

B. Materials: Along pedestrian-oriented streets, parking structure façades shall be treated with high quality materials and given vertical articulation and emphasis compatible with the principle structure. The façade shall be designed to visually screen cars.

C. Entries: Pedestrian entries shall be clearly visible.

D. Bicycle Parking: Parking structures shall provide bicycle parking within the structure. It shall be located on the level closest to the street and/or a primary building entrance.

9.6	**Bicycle Parking Standards**	**8. The proposed text amendment will change the classification of bicycle facilities to short and long term, rather than a class or tiered system. This change removes the requirement that bike standards shall conform to the Association of Pedestrian and Bicycle Professional Bicycle Parking Guidelines. The text amendment expands on design standards that provide clarity during development review.** The current UDO determines bicycle parking requirements in a class system. The intent of class I or class II bicycle facilities was for long-term bicycle parking, while class III was for short-term bicycle parking. In addition, the class II description was overly complex and difficult to administer during the development review process. Staff is proposing combining both class I and class II into long-term bicycle parking and class III into short-term bicycle parking. Exiting standards for each type of facility are captured in the new subsections 9.6.2 Short-Term Bicycle Parking and 9.6.3 Long-Term Bicycle Parking.

~~Bicycle parking shall be provided by all non-residential, multi-family, recreation and industrial uses. Bicycle parking facilities required by this section shall be designed to provide convenient bicycle parking and to protect parked bicycles. Acceptable rack elements, rack location and access, rack area and site conditions such~~

UDO Section	Section Title	Staff Comment
~~as protection from the elements and visibility shall conform to the Association of Pedestrian and Bicycle Professionals Bicycle Parking Guidelines.~~		
9.6.1 (new section)	**General Provisions**	**9. The change adds standards that bike racks must be connected to the internal pedestrian network for the development.**
9.6.1 General Provisions A. Permanent off-street bicycle parking is required subject to the Off-Street Parking Schedule "A" in Section 9.4.A. B. Bicycle parking must be conveniently located and publicly accessible. A sidewalk will need to connect the bicycle parking facility to the rest of the internal pedestrian network.		
9.6.2 (new section)	**Short-Term Bicycle Parking**	**10. The text amendment adds a new section for short-term bicycle parking, replacing class III. The better defines the intent for short-term bicycle parking and adds existing siting standards from the current code.**
9.6.2 ~~Bicycle Parking Facilities~~ Short-Term Bicycle Parking A. Short-term bicycle parking provides customers and other visitors a convenient and readily accessible place to park. Required short-term parking must meet the following standards. 1. Short-term parking shall be located outside the building and located near the building entrance or use it is intended to serve.		
9.6.3 (new section)	**Long-Term Bicycle Parking**	**11. The text amendment adds a new section for long-term bicycle parking, replacing class I and class II bike facilities. The better defines the intent for long-term bicycle parking and provides siting standards.** The current code requires multi-family to use class I (bike lockers) or class II facilities that are sheltered. The code gives additional flexibility is allowing more locations for long-term bike parking in multi-family developments.
9.6.3 Long-Term Bicycle Parking A. Long-term bicycle parking provides employees, students, residents, commuters, and others who generally stay at a site for several hours a protected and secure place to park B. Multi-family developments shall meet the required minimum bicycle parking with long-term bicycle facilities. C. Required long-term parking must meet the following standards. 1. Long-term bicycle parking shall be covered and weather resistant. 2. Long-term bicycle parking shall be located near the building entrance it is intended to serve. a. Long-term bicycle parking may be located within an internal area accessible by the public (such as bike locker room) or located in stairwells. Storage within a multi-family dwelling unit would not be considered a long-term bicycle parking space.		
9.6.4 (former	**Bicycle Parking Design Standards**	**12. The text amendment removes the design standards for the class base system and clarifies existing standards in the current UDO for general**

UDO Section	Section Title	Staff Comment
9.6.1 and 9.6.2)		**design standards pertaining to the surface bike facilities should be placed on, siting, placement, and allowable rack types. Note that the images shown below are proposed to be removed as part of the amendment.**

~~Bicycle parking spaces shall be Class I, Class II, or Class III facilities. Racks which only support one wheel are not acceptable.~~

~~Class I: Bicycle lockers are generally rectangular enclosures, each holding one or 2 bicycles.~~

~~Class II: Bicycle parking racks which allow all 3 major components of the bicycle, back wheel, frame, and front wheel, to be locked, without removal of the front wheel.~~

~~Class III: Racks such as loop, post, rails, "A" and inverted "U" racks. Each rack provides 2 bicycle parking spaces. Common properties in a class III facility include its support of the bicycle with or without the front wheel removed and post or pipe dimensions which allow the lock to encompass the front tire and down post or the rear wheel and seat post. Class III facilities are recommended for short-term parking, although, in combination with shelter, they can be adequate for long-term storage.~~

~~9.6.2~~9.6.4 ~~General~~ Bicycle Parking Design Standards

~~9.6.2.1 Multi-Family Development: Required bicycle parking spaces in multi-family development shall be provided in Class I facilities, or in Class II or III facilities if shelter is provided to accommodate long-term storage. If completely enclosed garages or accessory storage structures of at least 8 feet by 6 feet that may be locked or otherwise secured by individual tenants are provided for every unit in a multi-family development, no additional bicycle parking shall be required.~~

A. Surfacing

9.6.4.1.1 Bicycle parking shall be provided on a hard-surface, all-weather pavement of asphalt or concrete. ~~with curb ramps installed as appropriate.~~

~~9.6.2.2 Signage: Where not clearly visible from the access way, directional signage shall be provided to route bicyclists to the bicycle parking facility.~~

~~9.6.2.3 Installation: Installation shall be according to the manufacturers' instructions.~~

B. Placement

1. Bicycle parking shall be located as to not interfere with pedestrian access.

2. Proposed bike parking facilities must comply with siting standards set forth in the MSSD.

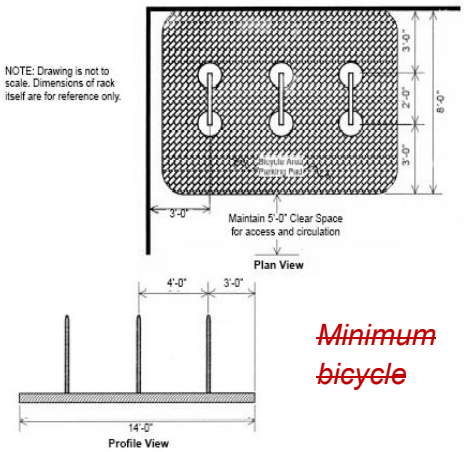
~~2.~~3. Bicycle parking shall be located 3 feet away from walls, fences, and the edge of landscaping at the time of maturity, as measured from the edge of the rack closest to the wall, fence, or landscaping.

UDO Section	Section Title	Staff Comment

~~3. Separated from automobile parking by a physical barrier or by at least 5 feet where automobile parking is prohibited and shall be located as close to public and employee entrances as possible without interfering with flow of pedestrian and vehicular traffic.~~

~~4. Conveniently located near entrances (where multiple entrances exist, the racks shall be dispersed among the entrances rather than located in large groupings)~~

~~Located so as not to interfere with pedestrian access.~~



~~the~~

~~*Minimum bicycle*~~

C. Rack Types

1. Grid bicycle racks shall not be permitted.

~~1.~~2. Bicycle lockers or similar types of facilities are permitted and count towards required bicycle parking standards.

15.3.1	**Sunshine List**	**13. The text amendment corrects an oversight during the 160D amendment process and states that the sunshine list is the Level 1 public notification.**

15.3.1 Level 1 – Sunshine List

A notice of the pending application/meeting shall be posted in a prominent location in Town Hall and on the town's web site, and a notice of such meeting shall be mailed, e-mailed, or delivered to each person and media provider that has filed a written request for notice with the Town Clerk. This notice shall be posted and mailed, e-mailed, or delivered at least 48 hours before the time of the meeting. Notices shall be distributed by email. Non-media members of this list shall be charged an annual fee (as set in the fee schedule) to receive all notices by mail. Members of this distribution list must renew their participation in this distribution on an annual basis.

15.17.2 15.17.4	**Comprehensive Plan Amendment**	**14. The text amendment removes Level 3 (Notification to Affected Property Owners), Level 4 (Notification to Adjacent Property Owners), and Level 5 (Neighborhood Meeting).** Statutory requirements only require Level 1 and Level 2 public notifications, and the inclusion of Level 3-5 was an oversight during the 160D amendment process. Table 15.2.4. Permit/Process Type shows the intended requirements as Level 1 and Level 2, and this change matches Table 15.2.4.

15.17.2 Review By The Planning Board

A. Public Comment Session Notification (Prior to Planning Board): Level 1, as defined in Section 15.3, is required for all amendments to the comprehensive plan. Levels 3 and 4 are only required for land use map amendments. ~~Levels 3 and 4 are required for all map amendments that involve a specific parcel of land. A Level 5 notification is required for Map Amendments.~~

~~B. Level 3 Notification for Large Scale Amendments: If the land development map amendment includes 50 or more properties, owned by at least 50 different property owners, the town may elect to utilize the~~

UDO Section	Section Title	Staff Comment
		~~expanded published notice provisions found in NCGS 160D, as outlined in Section 15.3.3.B of this chapter.~~ ~~C.~~B. Public Comment Session: The Planning Board shall conduct a public comment session and receive public input on the proposed amendment. Following the comment session to receive public input on the amendment, the Planning Board shall make a recommendation to the Board of Commissioners regarding whether to approve or deny each proposed amendment. ~~D.~~C. Delivery of Planning Board Recommendation: If the Planning Board is able to reach a recommendation without further deliberation, the Planning Board shall submit a recommendation on the matter and refer it to the Board of Commissioners for their consideration at their regularly scheduled legislative public hearing directly following the public comment session. If the Planning Board determines that further deliberation on the matter is required, the Planning Board shall render a decision on its recommendation to the Board of Commissioners within 45 days of its first consideration on the matter. If no recommendation is received from the Planning Board within 45 days of it first consideration on the matter, the Board of Commissioners shall proceed in its consideration of the matter without a recommendation from the Planning Board. 15.17.4 Consideration By Board of Commissioners A. Public Hearing Notification: Level 1 and 2, as defined in Section 15.3, are required for all amendments to the UDO. Levels 3 and 4 are only required for land use map amendments ~~Levels 3 and 4 are required for all map amendments (rezonings) that involve a specific parcel of land. Such actions include, but are not limited to, map amendments (rezonings), amendments to zoning district boundaries, and the application of new overlay zones. A Level 5 notification is required for Map Amendments.)~~ B. Public Hearing Consideration by the Board of Commissioners: Following receipt of a recommendation from the Planning Board, or after 45 days from the Planning Board public comment session if no recommendation is received, the Board of Commissioners shall conduct a legislative public hearing on the matter. Upon reviewing all of the pertinent information, the Board of Commissioners may: 1. Adopt the proposed amendment. 2. Adopt the proposed amendment with modifications. 3. Reject the proposed amendment. 4. Refer the proposed amendment back to the Planning Board for further consideration.
Appendix B - MSSD		**15. The text amendment officially removes the MSSD as an appendix to the UDO and clarifies that the MSSD is a manual to be used in the development review process.** In September 2018, staff presented a text amendment with the intent to make the MSSD a manual. However, the ordinance only removed the Appendix from the UDO Table of Contents. This text amendment reaffirms the decision in September 2018 and clarifies that the entire MSSD be removed as an appendix to the UDO.

Community Plan Consistency Grid				
GENERAL POLICY RECOMMENDATIONS		**YES**	**NO**	**NA**
GPR-1	Develop complete neighborhoods built around gathering spaces with a mix of housing types, lot sizes, and integrated commercial uses versus monolithic subdivisions			
GPR-2	Appropriately transition large-scale commercial, institutional, and industrial uses into surrounding neighborhoods			
GPR-3	Integrate alternative modes of transportation, such as transit and biking, into development			
GPR-4	Carefully configure street patterns to allow for multiple outlets from neighborhoods, and to continue the policy of providing for connections between neighborhoods, without encouraging through traffic			
GPR-5	Require sidewalks, bikeways and greenways as part of the necessary infrastructure for new development			
GPR-6	Require regularly spaced street trees, selected and planted in accordance with a street tree master plan, in new developments, whether commercial, office or residential			
GPR-7	Place new public and private buildings of architectural significance in locations of prominence and visual importance			
GPR-8	Ensure neighborhoods have adequate open space areas designed into the development			
GPR-9	Ensure residential architecture respects the value of the street upon which it faces with houses pulled up to the street, porches in the front, garages to the rear or setback from the rest of the home's front facade, and front walkways to the sidewalk			
POLICIES FOR OLDER NEIGHBORHOODS		**YES**	**NO**	**NA**
ON-1	Concentrate police protection, preferably in the form of foot and bicycle patrols, as part of a comprehensive strategy for neighborhood revitalization and crime prevention			
ON-2	Encourage pedestrian-level streetlights and appropriately designed private property lights , particularly in the town's older walkable neighborhoods			
ON-3	Implement housing programs, code enforcement activities, and public improvements in partnership with residents in targeted neighborhood areas and include restoration and rehabilitation activities			
ON-4	Ensure new infill development is architecturally compatible with existing structures, site layout and the streetscape within its vicinity			
ON-5	Continually reinvest in the infrastructure of older urban neighborhoods, including but not limited to: park improvements, sidewalks, street paving and maintenance, street trees, street lights, water and sewer lines, and drainage			
ON-6	Encourage pedestrian-oriented, designed and scaled stores and services providing basic necessities to residents of the town's older neighborhoods			
ON-7	Facilitate mass transit services through recognition of planned transit routes, development mix and density, and accommodation for future transit stop locations in redevelopment and infill projects in older neighborhoods			
POLICIES FOR NEWER NEIGHBORHOODS		**YES**	**NO**	**NA**
NN-1	Encourage architecturally compatible accessory housing on developed lots within existing neighborhood areas, especially for the elderly			
NN-2	Working in cooperation with neighborhood residents, support the provision of greenways, bikeways and walkways within existing neighborhoods			
NN-3	Architecturally compatible, residentially scaled office and institutional development may be permitted along major streets forming a boundary of a neighborhood planning area			
NN-4	Existing, less intensive development (i.e. residential or office uses) located at the intersection of two or more major streets may be allowed to undergo an orderly transition to appropriate commercial use, provided that original use is no longer viable and that careful site design will allow for compatibility with adjoining areas			

Community Plan Consistency Grid

POLICIES FOR FUTURE NEIGHBORHOODS		YES	NO	NA
FN-1	Promote a walkable community to minimize sprawl, as most new neighborhoods should be compact in form			
FN-2	Ensure new neighborhood streets are no wider than necessary to serve their intended purpose			
FN-3	Consider future transit service corridors and reinforce these corridors with development mixtures and densities appropriate for transit services			
FN-4	Include at least one neighborhood center or focal point in neighborhood planning areas			
FN-5	Encourage neighborhood serving businesses in neighborhood design			
FN-6	Encourage centrally located amenity centers and discourage them on the periphery of neighborhoods			
FN-7	Encourage a mixture of housing types, sizes, and prices for each neighborhood planning area			
FN-8	Encourage higher density housing that is served by transit and located close to adjoining work and shopping areas			
FN-9	Ensure new neighborhoods are connected to other neighborhoods, shopping, and work areas within the neighborhood planning area			
FN-10	Ensure street design gives equal priority to pedestrians and automobiles			
FN-11	Recognize bike routes and greenways in neighborhoods at the time of development			

POLICIES FOR EXISTING COMMERCIAL AREAS		YES	NO	NA
EC-1	Encourage appropriate landscaping and reconfiguration of large, existing unlandscaped parking areas.			
EC-2	Encourage the provision of convenience clusters for pedestrians, bicyclists and future transit services at strategic locations in existing commercial areas			
EC-3	Encourage the consolidation of commercial driveways onto major streets and the connection of adjacent parking lots			
EC-4	Encourage businesses to replace existing, non-conforming signage with more attractive, conforming signage.			
EC-5	Encourage new infill development across the front street face of existing, over-designed parking lots			
EC-6	Continue to prohibit billboards within the planning jurisdiction of Wake Forest			
EC-7	Ensure bicycle and pedestrian access to existing commercial areas			

POLICIES FOR FUTURE LARGE-SCALE COMMERCIAL AREAS		YES	NO	NA
LSC-1	Encourage large-scale commercial developments where appropriate, to contain a diverse mixture of retail, office, restaurant and service uses			
LSC-2	Locate large-scale commercial uses on the corners of neighborhood planning areas, that is, at the intersection of two or more major streets			
LSC-3	Allow planned mixed-use developments which allow for a compatible mixture of residential and non-residential uses with a pedestrian scale and design should be encouraged			
LSC-4	In planning for a new large scale development, buffer large-scale uses from adjacent residential areas by smaller scale buildings or by buffer strips			
LSC-5	Except for limited access highways, pull up new commercial buildings to the street; parking should be placed to the rear or side of the structure			
LSC-6	When appropriate, require the use of all around architecture (high quality facades on all sides of a building)			
LSC-7	Plan ahead for new large-scale commercial development in regards to future public transit stops and convenience clusters			
LSC-8	Limit driveway access for new large-scale commercial development to major thoroughfares and connect all adjacent parking lots			
LSC-9	Cluster together auto dealerships, large equipment sales and other businesses primarily dependent upon expansive outdoor sales lots for both functional and economic reasons			
LSC-10	Strongly discourage the abandonment of “big box” retail stores, for the purpose of relocating to another “bigger box” location in the community			

Community Plan Consistency Grid				
POLICIES FOR SMALL SCALE NEIGHBORHOOD BUSINESSES		**YES**	**NO**	**NA**
SSB-1	Encourage small scale, pedestrian-oriented shopping and work places in the design of new neighborhoods			
SSB-2	Locate neighborhood businesses at center of planning area rather than major thoroughfares			
SSB-3	Ensure neighborhood businesses are designed at a residential scale and character			
SSB-4	Coordinate the location of neighborhood serving businesses with bikeways and, where appropriate, future transit stops			
SSB-5	Employ on-street parking in coordination with a limited amount of off-street parking for neighborhood serving businesses			
SSB-6	Ensure neighborhood businesses have residential scale signage and lighting			
SSB-7	Ensure neighborhood businesses encouraged as upfront infrastructure cost of new development			
SSB-8	Ensure neighborhood businesses locate near public amenities if opportunity allows			
SSB-9	Encourage living quarters over small retail shops and offices			
POLICIES FOR FIRST GENERATION BUSINESS AND INDUSTRIAL AREAS		**YES**	**NO**	**NA**
FGI-1	Actively participate, facilitate and partner in the adaptive reuse and conversion of former production, warehousing and manufacturing buildings into uses compatible with their design and location			
FGI-2	If the demolition of an old industrial building or complex becomes necessary, any new structure(s) and site redevelopment should be compatible with the neighborhood context; such redevelopment should serve to improve the quality, character and livability of the surrounding area			
POLICIES FOR SECOND GENERATION BUSINESS AND INDUSTRIAL AREAS		**YES**	**NO**	**NA**
SGI-1	Encourage and support the rehabilitation, improvement, and re-occupancy of viable business and industrial properties that have become vacant.			
SGI-2	The Town of Wake Forest acknowledges and supports the work of state and federal agencies, as well as its own town building inspectors, concerning the enforcement of environmental regulations and building standards, particularly concerning the redevelopment or adaptive reuse of manufacturing sites and buildings			
POLICIES FOR THIRD GENERATION BUSINESS AND INDUSTRIAL AREAS		**YES**	**NO**	**NA**
TGI-1	Periodically examine zoning ordinance and other development regulations to maintain or update appropriate standards and locations for manufacturing, warehouse and distribution opportunities within the Town's planning jurisdiction			
TGI-2	Employ industrial development performance standards to promote the establishment or expansion of industries that are compatible with the public health, safety, and welfare of area residents, and that are supportive of the long term economic prosperity and environmental quality of the community			
TGI-3	Provide and maintain adequate screening and buffering between residential areas and newly developed industrial sites			
TGI-4	Ensure industrial and warehouse sites located within view of a public right-of-way or nearby property provide landscaping that enhances the property and is consistent with a quality image			

Community Plan Consistency Grid				
POLICIES FOR DOWNTOWN		**YES**	**NO**	**NA**
D-1	Encourage a compatible, diverse mixture of retail, office, institutional, residential, dining, services, entertainment, and public open space in the downtown area			
D-2	Recognize the advantages of clustering similar activities and development forms in appropriate parts of the downtown			
D-3	Expand pedestrian oriented streetscape improvements, including wider sidewalks, street trees, decorative street lights, street furniture, and landscaping			
D-4	Direct new and expanding businesses to compatible buildings and sites in or near the downtown area			
D-5	Reserve ground floor space for retail uses with office and other uses on upper floors			
D-6	Maintain a tangible presence and committment to the downtown through the location of the Town's major municipal offices there and encourage other local, state and federal government agencies to maintain similar commitments to the downtown			
D-7	Continue to support the Wake Forest farmers market at the municipal parking lot in downtown Wake Forest			
D-8	Continue to utilize the Renaissance Area Urban Code to ensure that development and redevelopment will be supportive of the architectural and historic context that is vital to the economic success of downtown Wake Forest			
D-9	Encourage efforts to restore missing or underutilized street frontages, particularly on lots where previous buildings have been demolished and replaced with (oftentimes) surface parking			
D-10	Locate parking lots to the side or behind buildings or in the interior of the block with off-street parking spaces for multi-family buildings being in the rear yard			
POLICIES FOR PARKS, OPEN SPACE AND RECREATION		**YES**	**NO**	**NA**
PR-1	In cooperation with private sector interests, develop a system of open space greenways and walking trails to connect to residential areas with, especially, schools and park facilities			
PR-2	Include mini-parks in existing and proposed developments to meet the needs of small children and the elderly, and to encourage social interaction and mutual support among area families			
PR-3	Locate parks in full view of residential/non-residential activity for security			
PR-4	Provide funding to help demand for open space and recreation created by development			
PR-5	Co-locate parks & recreation facilities with schools, utility companies, and federal, state and local government agencies			
PR-6	Continue to seek efficiencies, cost savings, and quality services for park maintenance as the Town grows			
PR-7	Continue to explore new opportunities for providing recreation programs with all available partners			
POLICIES FOR MAJOR STREETS		**YES**	**NO**	**NA**
S-1	Space major streets no more than 1 mile apart			
S-2	Ensure access to undeveloped sections of major streets are from intersecting minor streets, rather than private driveways			
S-3	Ensure minor streets intersect major streets regularly at approximately every 400 to 600 feet			
S-4	Incorporate central medians into the design of new or improved major streets			
S-5	Plant landscaping, and where possible, street trees in central medians of major streets			
S-6	Plant and retain streetyard vegatation along major streets to soften and unify the streetscape			
S-7	Ensure contrasting streetyards along major streets for change in visual character			
S-8	Preserve and enhance natural, cultural and historic features along major streets			
S-9	Ensure parking areas are screened from view within major street corridors			
S-10	Employ special roadway overlay zoning to help implement corridor plans			
S-11	Ensure road widenings and/or one-way pairs are avoided for streets where the original design intent and relationship to adjoining land uses was otherwise			

Community Plan Consistency Grid

POLICIES FOR MINOR STREETS		YES	NO	NA
S-12	Encourage street patterns that respond to site topography, accentuate focal points and interesting vistas, create interesting public spaces and intersections, and that are coordinated with the placement of significant structures or open spaces			
S-13	Consider incorporation of medians in neighborhood axial streets			
S-14	Create short blocks of 300-500 feet in length to allow for many alternative routes for walking and biking, as well as a beneficial network of local streets			
S-15	Design street widths to fit the intended use of the street, corresponding to the traffic load and planned development types			
S-16	Employ a fully-connected honeycomb of streets to promote convenient circulation within the neighborhood and provide for multiple, alternative outlets from the area to adjoining neighborhoods and major streets			
S-17	Encourage on-street parking in compact neighborhoods			
S-18	Utilize grass swales to capture runoff in conservation subdivisions			
S-19	Ensure turning radius of corners at intersections are as small as possible to shorten the street crossing distance for pedestrians at intersections			
S-20	Install traffic calming methods as necessary to enhance livability			

POLICIES FOR SIDEWALKS		YES	NO	NA
SW-1	Where no sidewalks are present, provide sidewalks in existing developed areas to connect residential areas to walkable pedestrian destinations			
SW-2	Ensure sidewalks are required on both sides of the street in new developments when along thoroughfares and collectors, in multi-family developments, in “front porch” developments, and along local streets within walking distance of a major pedestrian trip attractor			
SW-3	Ensure sidewalk widths correspond with anticipated pedestrian traffic volumes, adjoining land uses, and sidewalk activities with minimum sidewalk widths at 5 feet, or 6 feet if along the verge of a street			
SW-4	Continue curb stamp installation and retrofit curb ramps in existing sidewalks			
SW-5	Ensure crosswalks are plainly marked and well lit, especially where significant pedestrian activity is observed or expected			

POLICIES FOR BIKEWAYS		YES	NO	NA
B-1	The bicycle facility selection guide, as used by the Federal Highway Administration, shall be employed for determining the most suitable type of bicycle facility for any new or upgraded roads in Wake Forest			
B-2	Facilitate bicycle and pedestrian way connections between neighborhoods, either by street or connecting path, to enable the effective use of local, minor streets for pedestrian and bicycle trave			
B-3	Install striped bicylce lanes and appropriate signage along existing streets where called for in the Bicycle Plan			
B-4	Install striped bicylce lanes and appropriate signage along new collector streets			
B-5	Install bicycle-responsive signals at intersections where appropriate			
B-6	Ensure all new public and private developments have bike parking and bicycle access			
B-7	Examine all future road construction and improvements for bikeway feasibility and conformity with the Town of Wake Forest Bicycle Plan			
B-8	Examine all future developments and site plans for bicycle compatibility and conformity with the town Bicycle Plan			
B-9	Include bicycle facilities and their impacts in traffic impact analyses for new private developments			
B-10	Establish and implement pedestrian and bicycle friendly schools zones around all schools			
B-11	Ensure bicycle-related improvements are an integral component of the Town’s annual budget for public infrastructure investment			

Community Plan Consistency Grid				
POLICIES FOR GREENWAY TRAILS		**YES**	**NO**	**NA**
GT-1	Continue to pursue a greenway trails system that connects residential areas with schools and park facilities			
GT-2	Develop greenway trails in accordance with the environmental conditions of its corridor, its intended use for travel versus recreation, and the anticipated traffic volume of pedestrians and bicyclists			
GT-3	Ensure greenway construction is treated as a normal element of infrastructure necessary to support new development			
GT-4	Ensure greenway maintenance and safety in Town control after transfer from private control			
POLICIES FOR PUBLIC TRANSPORTATION		**YES**	**NO**	**NA**
PT-1	Support the successful operation and expansion of transit with compact, transit-compatible development patterns			
PT-2	Require site planning that incorporates transit stops and convenience clusters			
POLICIES FOR STREET TREES		**YES**	**NO**	**NA**
ST-1	Prepare and maintain an official Street Tree Planting Master Plan			
ST-2	Ensure consistent street tree species occur along certain sections of streets			
ST-3	Ensure a diversity of street tree species Town wide with no single species comprising more than 10-15% of total trees			
ST-4	Install regularly spaced street trees in central medians and frontage street medians			
ST-5	Continue to require The planting or preservation of street trees of appropriate size and species			
ST-6	Maximize available budget dollars for street tree master plan implementation			
POLICIES FOR STREETLIGHTS		**YES**	**NO**	**NA**
SL-1	Ensure streetlights are installed according to the design speed and/or intended use of the street or area they serve			
SL-2	Periodically evaluate emerging lighting technologies for best color, brightness and energy efficiency			
SL-3	Continue to develop and implement joint policies and standards for street light selection, installation, operation and maintenance in cooperation with Wake Electric and Duke/Progress Energy			
SL-4	Ensure streetlights are installed on both sides of streets unless a newly approved street is planned from the outset to have a sidewalk on only one side			
POLICIES FOR UTILITY POLES AND WIRES		**YES**	**NO**	**NA**
UPW-1	Maintain a master plan for the undergrounding of utilities, with priority given to pre-determined areas			
UPW-2	Ensure major town entrances and gateway corridors receive first priority for the undergrounding of overhead utilities			
UPW-3	Ensure high visibility, pedestrian-oriented areas receive second priority for the undergrounding of overhead utilities			
UPW-4	Ensure overhead utilities in other priority areas are placed underground or relocated as opportunities arise			
POLICIES FOR WIRELESS TELECOMMUNICATION FACILITIES		**YES**	**NO**	**NA**
WTF-1	Facilitate the development of wireless service technology as an economic development asset and significant benefit to the town and its residents			
WTF-2	Ensure the impacts of wireless telecommunication facilities should not be permitted to compromise the health, safety and public welfare of area residents; nor should such facilities be allowed to diminish the character of the community and visual quality of its environment			
WTF-3	Ensure that in residential areas, historic districts and the Renaissance districts, cell towers are only considered when there is no alternative for serving those areas and no other alternative wireless telecommunication structure can be utilized			
WTF-4	Initiate updates to standards for wireless telecommunication facilities as new technologies and structural requirements for wireless capabilities emerge over time			

Community Plan Consistency Grid				
POLICIES FOR TOWN AND SPECIAL AREA ENTRANCES		**YES**	**NO**	**NA**
TSE-1	Employ noticeable streetscape improvements to clearly announce a town entrance and to enhance gateway corridors			
TSE-2	Extend streetscape improvements as the Town limits expand			
TSE-3	Employ special "gateway" treatment where where a bridge, underpass, overpass or other roadway feature is located at an entry point to the town or some portion of it			
POLICIES FOR COMMUNITY CHARACTER		**YES**	**NO**	**NA**
CC-1	Employ architectural standards consistent with Wake Forest's architectural character for new, expanding, or improved businesses			
CC-2	Exceptional locations, views and vistas in the town should receive exceptional treatment and/or protection in design and development			
CC-3	Place noteworthy buildings, important outdoor spaces, objects of historic merit, important monuments, and significant works of art in positions of visibility and prominence			
CC-4	Incorporate significant natural and existing man-made elements into the thematic design of new developments			
CC-5	Save large trees, ponds, creeks, or other natural features of the landscape when locating new streets, buildings,parking lots, etc			
CC-6	Support community character by ensuring development is compatible with surrounding area			
CC-7	Ensure exterior lighting is attractive, functional and safety conscious, while also avoiding negative impacts on the night sky visibility of Wake Forest			
POLICIES FOR REGIONAL TRANSPORTATION		**YES**	**NO**	**NA**
RT-1	Continue to anticipate and plan for the impacts of new high speed rail service as it passes through Wake Forest en route to major urban centers north and south along the east coast			
RT-2	Continue to anticipate and plan for the transformation of US 1 Capital Blvd into a limited access freeway and multi-modal transportation corridor as per the plans of the US 1 Corridor Study			
RT-3	Support the express bus service between downtown Wake Forest and downtown Raleigh			
POLICIES FOR WATER AND SEWER		**YES**	**NO**	**NA**
WS-1	Work proactively with other local governments, utility service providers, and the State of North Carolina on regional, long term solutions for water supplies and sewage treatment			
WS-2	Place water and sewer utilities in areas where growth is desired			
WS-3	Avoid placing sewer utilities in environmentally sensitive areas or in areas where open space is desired			
WS-4	Encourage the development of sewer services that employ water reuse technologoes			
POLICIES FOR WATER CONSERVATION		**YES**	**NO**	**NA**
WC-1	Conserve, to the fullest extent possible, potable water and waste water treatment capacity			
WC-2	Employ other types of non-municipal water supplies such as wells, rainwater catching systems, rain barrels and in-ground cisterns			
WC-3	Eliminate or reduce usage of the municipal water supply for outside irrigation			
WC-4	Encourage new development to plant drought tolerant grasses on lawns			
WC-5	Encourage construction of new rainwater retainage systems			
WC-6	Encourage new development to include traditional plants native to the area			
WC-7	Encourage the installation of water saving devices in new and existing development			

Community Plan Consistency Grid				
POLICIES FOR COMMUNITY ORIENTED SCHOOLS		**YES**	**NO**	**NA**
S-1	Plan for new school locations in advance through joint collaboration between the Town and School Board — with emphasis on steering facilities to desirable growth areas and avoiding sprawl			
S-2	Encourage offering land for new school facilities, particularly in conjunction with related neighborhood development			
S-3	Design safe campuses with pedestrian access to adjoining neighborhoods			
S-4	Prioritize traffic management and safety in the vicinity of public schools			
S-5	Co-locate school facilities with other community facilities and services			
S-6	Ensure costs for new schools should be borne largely by new growth and development creating the demand			
S-7	Foster diversity in community-oriented public schools by encouraging diversity in nearby neighborhoods feeding each school			
POLICIES FOR PAYING FOR GROWTH		**YES**	**NO**	**NA**
PFG-1	Ensure the costs of infrastructure, facilities and services related to new growth and development should be borne primarily by those creating the demand			
PFG-2	Continually seek to balance residential and non-residential development to foster a favorable service-cost to revenue-generated tax base			
PFG-3	Fees charged by the Town for development reviews and inspections should approximate the actual costs to the Town of conducting such work			
PFG-4	Explore cost recovery fees for new "greenfield" development			
PFG-5	Undertake annual planning and budegting for capital facilities			
POLICIES FOR A HEALTHY SUSTAINABLE ENVIRONMENT		**YES**	**NO**	**NA**
HSE-1	Ensure development policies work to make Wake Forest more walkable and pedestrian-friendly, and less dependent on the single-occupant automobile			
HSE-2	Encourage compact, transit-oriented, mixed-use developments to facilitate walking, biking and transit options			
HSE-3	Locate new higher density residential development within walking distance of jobs and services and design it to be transit compatible with current and future transit services			
HSE-4	Recognize and facilitate low impact development			
HSE-5	Ensure runoff and drainage from development is of a quality and quantity as near to natural conditions as possible			
HSE-6	Require vegetative riparian buffers along all creeks, rivers, lakes and other water bodies in Wake Forest			
HSE-7	Encourage conservation subdivisions where site conditions call for minimizing environmental disturbance and protecting adjoining natural resources			
HSE-8	Ensure large parking lots have landscaped planting islands and perimeter buffer strips and may use other design technologies to intercept and absorb runoff			
HSE-9	Carefully control development activities in the special flood hazard areas			
HSE-10	Encourage the construction of energy efficient structures, including the use of "green" building design			
HSE-11	Ensure site plans for new development work sympathetically with the natural features of the land, including existing topography and significant existing vegetation			
HSE-12	Explore a combination of incentives and disincentives to protect existing trees and/or require the replacement of trees removed for development			
HSE-13	Encourage green infrastructure (grassed swales, rain gardens, bio-retention strips, cisterns, rain barrels, permeable pavements, etc.)			
HSE-14	Offer a variety of solid waste reduction strategies and services including educational programs on waste prevention, recycling and reuse			
HSE-15	Facilitate proper disposal of household hazardous waste materials			
HSE-16	Encourage on-site residential composting			
HSE-17	Continue off-site mulching and redistribution of landscape yard waste			
HSE-18	Continue to support education and activities that reduce litter and illegal dumping			
HSE-19	Continue to plan in advance for area requirements concerning solid waste collection and disposal			

Community Plan Consistency Grid

POLICIES FOR ECONOMIC DEVELOPMENT		YES	NO	NA
ED-1	Encourage new and expanding industries and businesses that are compatible with the long-term quality of the area's natural and cultural resources, match up well with the area's infrastructure and services, employ and develop the skills of area workers, and diversify the local economy			
ED-2	Retain quality businesses and to attract new ones continue to invest in infrastructure and services that sustain and enhance the area's already high quality of life, image and cultural identity			
ED-3	Pursue economic and business development partnerships between the Town, other local jurisdictions, other economic development organizations, and private companies			
ED-4	Strive for a financial and regulatory environment that supports the establishment and growth of small business			
ED-5	Develop real estate "product" suitable for business placement that focuses on the identification, enhancement and certification of buildings and sites readily available for construction and/or occupancy			

POLICIES FOR ARTS CULTURE AND HISTORIC PRESERVATION		YES	NO	NA
ACH-1	Encourage efforts and actively participate in the provision of indoor and outdoor public and private spaces to showcase the work of visual and performing artists in Wake Forest			
ACH-2	Encourage new private sector developments to include art as an integral element of privately owned common areas and semi-public spaces			
ACH-3	Ensure budgets for new construction and renovations of town buildings include a line item for the purchase and display of art			
ACH-4	Continue to have cultural arts be enhanced as a permanent function of the Town's recreation program offerings			
ACH-5	Employ design standards that ensure development and redevelopment is consistent with the architectural context, community character, economic attractiveness and livability of Wake Forest			
ACH-6	Encourage the identification, restoration, and active use of structures, buildings, monuments, landmarks, sites and neighborhoods of historic or architectural significance			
ACH-7	Strongly discourage the destruction of architectural, historic, and archealogical resources of Wake Forest			

POLICIES FOR PUBLIC SAFETY		YES	NO	NA
PS-1	Employ community education, school, and public involvement programs to enhance community awareness of public safety issues			
PS-2	Periodically review the need for additional paid personnel, capital improvements and equipment needs to meet or exceed public safety standards, insurance ratings and other measures of public safety			
PS-3	Strategically locate additional public safety substations, provided that sufficient resources can be made available to properly staff and equip them			
PS-4	Proactively support legislative efforts to strengthen local law enforcement tools			
PS-5	Employ a holistic approach to public safety involving residents, businesses, and institutions in the preparation of neighborhood improvement plans, with priority given to public safety concerns			
PS-6	Encourage excellence in law enforcement, fire protection, and emergency services through on-going education, training and participation in national accreditation programs			
PS-7	Support the establishment of an east-west through street (or loop road) on the north side of town to improve emergency access to locations in that area			

POLICIES FOR LEADERSHIP AND COMMUNITY INVOLVEMENT		YES	NO	NA
LCI-1	Continue to emphasize the importance of advisory boards & committees in conducting the Town's business			
LCI-2	Ensure boards and committees of the Town are representative of the population and geography of the planning area or subject matter being addressed			
LCI-3	Encourage public involvement in decisions on land use and development by making the public aware of proposed developments at the earliest lawful opportunity, as well as fostering communication between developers and the general public			
LCI-4	Encourage neighborhood and special area planning			
LCI-5	Continue to ensure maintenance and enhancements to the Town's internet and multi-media news dissemination capabilities			
LCI-6	Participate proactively in the cooperation of efforts among civic and volunteer organizations for maximum impact in the community			

Rennaissance Plan Consistency Grid

POLICIES FOR SUCCESSFUL DOWNTOWNS		YES	NO	NA
SD-1	Maintain and develop short blocks and a dense street network for enhanced walkability and increased connectivity			
SD-2	Provide ample on-street parking to support retail and act as an inherent traffic calming element			
SD-3	Ensure continuous building facade frontages along streets to keep pedestrians and bicyclists interested while traveling along the street			
SD-4	Balance the ratio of building height to street width to achieve a comfortable public realm			
SD-5	Provide and program a diversity of high quality public spaces			
SD-6	Manage parking with thoughtful consideration of location and actual need over the quantity of spaces			
SD-7	Provide active and engaging ground floor uses for downtown buildings			
SD-8	Work with businesses to encourage their hours of operation(s) go beyond 5 PM			
SD-9	Provide ample ambient lighting for both safety and interest			
SD-10	Locate restaurants in close proximity to one another to effectively concentrate a variety of options for visitors			
SD-11	Attract businesses and other uses that provide daytime employment			
SD-12	Provide high-end commercial activity			
SD-13	Increase the amount of pedestrian activity			
SD-14	Provide adequate accessibility and wayfinding for pedestrians			
SD-15	Ensure new building heights are between 2 and 4 stories			
SD-16	Ensure development is easily accessible to transit to accommodate higher volumes of users without adding pressure on parking			
SD-17	Provide dynamic activity with a mixture of sidewalk displays, outdoor dining, creative signage, diverse public spaces, and enticing window shopping			
SD-18	Incorporate unique and enticing human-scaled design features into new development			
SD-19	Attract diverse residential and employment centers within a 5 to 10-minute walk of downtown			
SD-20	Streets shall accommodate two-way, multi-modal traffic with on-street parking, street trees and furnishings			

POLICIES FOR RETAIL STRATEGY		YES	NO	NA
RS-1	Locate Retail Merchandising Units (RMUs) on sites slated, but not ready for redevelopment			
RS-2	Convene stakeholders to generate strategies for marketing downtown and facilitating new retail			
RS-3	Work to attract visitation from nearby neighborhoods/subdivisions			
RS-4	Require active ground floor uses based on the existing character and realistic aspirations for particular streets or areas			
RS-5	Make more efficient use of existing resources and condition motorists to consider parking spaces a little further than directly by their destination			

POLICIES FOR CONNECTIVITY TO THE CORE		YES	NO	NA
CC-1	Build on the identified centers of energy and ensure multi-modal connectivity between them			
CC-2	Transform Owen Street into a festival street that connects the retail core to the civic core with a unique urban experience			
CC-3	Build the Downtown Connection greenway and add a connection from Deacon Ridge Street to Franklin Street at mid-block			
CC-4	Fill any identified gaps in the sidewalk network and construct new sidewalks where suggested			
CC-5	Continue to complete streetscape improvements throughout the Renaissance Area prioritizing those that improve safety			

Rennaissance Plan Consistency Grid

POLICIES FOR MANAGING CARS		YES	NO	NA
MC-1	Enforce timed parking spaces to create more frequent turnover and availability of those parking spaces			
MC-2	Where feasible, consolidate driveway entrances and reduce curb cuts			
MC-3	Add parking spaces along Taylor Street behind Town Hall			
MC-4	Coordinate shared parking strategies with private lot owners to more efficently utilize parking facilites			
MC-5	Install signage for private lots with shared parking agreements			
MC-6	Investigate the use of the Wake Forest Baptist Church lots for downtown employee parking so that parking spots closer to retail can be used by visitors			
MC-7	Add a pay station to the White Street public parking lot if site continues to be used as public parking area			
MC-8	Meter White Street parking spaces once enforcement of time limits is implemented			
MC-9	Over time, increase public transportation access as well as parking fees for metered spots and public lots			
MC-10	Build a public parking deck to serve a specialized development, and potentially, nearby uses			

POLICIES FOR CREATING A DESTINATION		YES	NO	NA
CD-1	Connect public gathering spaces, so there is a safe, enjoyable journey between them			
CD-2	Identify and implement an interactive civic space in downtown Wake Forest that attracts families through play and water			
CD-3	Develop a community art master plan which identifies opportunities for building murals, sculptures and other forms of creative thinking			
CD-4	Hire an event coordinator to manage, promote and execute Town related activities/festivals			

POLICIES FOR PUTTING PEOPLE FIRST		YES	NO	NA
PPF-1	Implement small-scale tactical improvements to the downtown area, such as parklets, temporary art installations, closed street events, and temporary seating or dining areas.			
PPF-2	Test outdoor dining at The Forks to add outdoor vibrancy and encourage pedestrian activity on Elm Avenue			
PPF-3	Restripe Elm Avenue to include bike lanes to give the east side a dedicated bicycle facility connecting them to downtown			
PPF-4	Install a temporary parklet in the loading zone; upon evaluation of its success, consider enhanced permanent features for the space			
PPF-5	Transform the intersection of Roosevelt Avenue and Front Street into a prominent gateway to downtown Wake Forest			
PPF-6	Transform the pedestrian pathway across the rail line into an art walk to downtown Wake Forest			
PPF-7	Use interesting lighting techniques to make the bridge an iconic and memorable feature of downtown			
PPF-8	Encourage the revitalization of 153 South White Street through strategic renovations			
PPF-9	Create a master list of opportunities and seek civic organizations to partner with in order to test a range of opportunities using tactical techniques			
PPF-10	Layer the downtown environment incrementally with additional furnishings, lighting and landscaping			
PPF-11	Research best practices in public Wi-Fi program implementation and management and subsequently implement public Wi-Fi in the Renaissance Area			
PPF-12	Add ideal spatial enclosure ratios to the Unified Development Ordinance			
PPF-13	Amend the Unified Development Ordinance to better achieve ideal building heights			
PPF-14	Amend the existing Required Shopfront Overlay District to include additional frontages			

Rennaissance Plan Consistency Grid				
POLICIES FOR DEVELOPMENT AND REDEVELOPMENT OPPORTUNITIES		**YES**	**NO**	**NA**
DRDO-1	Connect the Northeast Community with downtown through a transitional redevelopment area comprised of new mixed-use infill development, renovated buildings, multi-family housing, single-family housing, and walkable street block sizes			
DRDO-2	Encourage the renovation and adaptive reuse of the garage building on Roosevelt Avenue			
DRDO-3	Transform the public and private realm of Wait Avenue and Roosevelt Avenue with redevelopment, adaptive reuse of older buildings, and new mixed-use infill development			
DRDO-4	Close a portion of Wait Avenue and consolidate the block to better accommodate a cohesive redevelopment and contribute in a positive way to downtown			
DRDO-5	Encourage infill and redevelopment along Owen Avenue to serve as a catalytic project that would add vibrancy to a key intersection in the historic core			
DRDO-6	Encourage infill development on vacant and underutilized lots on White Street to maintain a consistent and attractive street edge			
DRDO-7	Explore development and redevelopment of large parcels of land along South White Street, south of Elm Avenue, with primary focus on a mix of multi-family over retail, townhomes and civic buildings			
DRDO-8	Connect the Senior Center to downtown via Brooks Street and ensure that the public streetscape and the frontages of private development contribute to a highly walkable street			
DRDO-9	Replace some of the unsightly and underperforming parking lot area in front of the Renaissance Center with new, mixed-use outparcel development			
DRDO-10	Encourage new mixed-use, infill development and redevelopment of areas around the intersection of Elm Avenue and S. White Street			
POLICIES FOR IMPLEMENTATION STRATEGIES		**YES**	**NO**	**NA**
IS-1	Promote more frequent, smaller events in downtown that are more seasonally predictable and recurring			
IS-2	Attract a broad array of user groups, specifically children and college students, to downtown through strategic programming			

Northeast Community Plan Consistency Grid

POLICIES FOR PRESERVING AND PROTECTING		YES	NO	NA
PP-1	Identify programs, initiatives, targeted funding mechanisms, counseling, and educational opportunities to allow existing residents flexibility in maintaining their chosen place of residence			
PP-2	Update the UDO to require appropriate transitions and buffers between new commercial development and residential neighborhoods			
PP-3	Identify additional green spaces and small-scale social gathering places (e.g. community gardens, pocket parks, playgrounds, etc.) in the Northeast Community and explore opportunities to add these spaces to the open space, greenway, and parks network			
PP-4	Modernize Ailey Young Park to align with other community park improvements. Assess the demands and desires of the community's recreational needs and explore potential improvements at the park			
PP-5	Continue to implement tree planting programs and identify potential locations for additional tree planting			
PP-6	Continue to identify masses of mature and specimen trees throughout the community and encourage their protection where feasible			
PP-7	Identify additional local historic sites within the Northeast Community through engagement activities with local leaders, groups, and places of worship			
PP-8	Work with national, state and local historic preservation programs to formally protect identified historic and culturally significant sites in the Northeast Community			
PP-9	Preserve the Ailey Young House as an African-American heritage site. The site can act as a gateway into the community, as well as a place to celebrate the African-American heritage of Wake Forest			
PP-10	Identify opportunities to provide educational programming to tell the stories of local historic sites and their role in both the Northeast Community and Town of Wake Forest			
PP-11	Continue to install historic markers or other interpretive material at historic sites			
PP-12	Explore the establishment of a historic district and/or cultural landscape to preserve the historic character of the Northeast			
PP-13	Promote maintenance of roadways including street cleaning, shrub maintenance along streets, etc			

POLICIES TO FLOURISH		YES	NO	NA
F-1	Focus additional residential and non-residential growth as per Future Land Use Map recommendations and explore rezoning targeted parcels (e.g., DuBois Campus, parcels along Wait Avenue) to accommodate and encourage non-residential uses			
F-2	Research potential in-fill development sites that could support future affordable housing development in the Northeast Community — which may include a mix of multi-family housing, attached single-family housing, and detached single-family housing			
F-3	Update the UDO to allow Accessory Commercial Units (ACU)			
F-4	Continue to include provisions for accessory dwelling units (ADUs) within development regulations, including future overlay districts, to encourage the creation of such units			
F-5	Establish an overlay zoning district to align new construction with existing orientation, massing, height, size, setback, building and scale. Determine building frontages applicable to each land use category based on research of existing lot widths			
F-6	Prepare and adopt discretionary guidelines to guide the design of residential and non-residential properties			
F-7	Perform a thorough analysis of utility infrastructure systems within the study area - including broadband network coverage. The analysis should be used to update the list of needed improvements in the study area, which may be carried out through the Town's Capital Improvements Plan or through coordination with utility agencies.			
F-8	Explore creation of community gateway improvements at key intersections including identifying signage (i.e. "Northeast Community). Such gateway improvements may include landscaping, public art, signage, lighting, etc			
F-9	Explore opportunities to provide spaces and programming options for the installation of public art, specifically at activity centers in and around the community			
F-10	Encourage the redevelopment of the W.E.B. DuBois School Campus to include uses and programming that benefit both the Alumni Association and surrounding neighborhood			

POLICIES TO CONNECT		YES	NO	NA
C-1	Design and install wayfinding, signage and interpretive panels at existing parks. Such signage may include maps of the larger scale greenway network in addition to information regarding specific locations. Wayfinding signage should consider both pedestrian and bicycle friendly scales as well as vehicular scale for visibility/legibility			
C-2	Implement the streetscape recommendations that align with the 2019 Comprehensive Transportation Plan (CTP – updated 2021)			
C-3	Implement the proposed bicycle, pedestrian, greenways, multiuse paths, roadway, and connectivity facilities outlined in the 2019 Comprehensive Transportation Plan (CTP - updated 2021)			

Northeast Community Plan Consistency Grid				
C-4	Conduct an ADA audit of existing bike and pedestrian facilities within the study area to ensure ADA compliance			
C-5	Consider opportunities to reduce speeding along neighborhood roadways. Interventions could include traffic calming installations, on-street parking to buffer pedestrians from automotive lanes and deter speeding, and warning signage at specific locations to deter cut-through traffic			
C-6	Continue coordination with NCDOT and GoRaleigh to advance the Wake Forest Commuter Rail (S-Line) initiative			
C-7	Explore innovative multimodal technologies (i.e. microtransit / micromobility) to give residents of the Northeast Community additional transportation options			
C-8	As the DuBois Campus redevelops, investigate enhancing the transit service in the study area to include stops in the northern and eastern portions of the study area			
C-9	Investigate the viability of adding a transit route to / from points north of the study area (i.e. Flaherty Park, Youngsville, etc.)			
POLICIES TO PARTNER		**YES**	**NO**	**NA**
P-1	Collaborate with Wake County to identify funding opportunities (e.g., Community Development Block Grants) for affordable housing and other neighborhood improvement activities			
P-2	Work with local community organizations (such as NECC, places of worship, Alumni Association, etc.) to understand needs and requirements for existing community celebrations, as well as identify additional opportunities for new community celebrations. As part of this effort, identify funding sources and collaborative partners to launch new community events			
P-3	Strengthen existing job training and mentorship programs that can be or are provided through local organizations in Wake Forest. Provide additional opportunities as new skills are needed. Enact additional job readiness programs, directed at younger and older residents, to help individuals transition into new jobs			
P-4	Work with local organizations to identify and implement youth programming such as mentoring, after school programs, daily homework initiatives, summer youth programs, recreation activities, etc			
P-5	Work with local organizations and religious institutions to identify and implement child care programming to help support working families in the Northeast Community			

Parks & Recreation Master Plan Consistency Grid				
POLICIES FOR IMPROVED INTERNAL AND EXTERNAL COMMUNICATION OF ACTIVITIES AND SERVICES		**YES**	**NO**	**x**
IEC-1	Make use of the Town's Marketing Plan to improve awareness park facilities			
IEC-2	Partner with the Communications Department and the Public Information Office to make the best use of the Town's website and social media outlets			
IEC-3	Adopt open lines of communications and meetings with partners and potential partners			
POLICIES FOR CREATING NEW STAFF ASSIGNMENTS OR NEW HIRES FOR ADDED RESPONSIBILITIES		**YES**	**NO**	**NA**
SANH-1	Add staff to the Maintenance Division to meet current and anticipated future demands			
SANH-2	Add staff for facility operations to meet demand for extended hours of operations for facilities			
SANH-3	Ensure that staffing resource levels can maintain existing and new facilities at or above acceptable standards as master plan is implemented			
SANH-4	Add staff to the Urban Forestry Division to meet anticipated future demands with development and expansion of the parks and greenways system			
POLICIES FOR EQUITABLE USER FEES		**YES**	**NO**	**NA**
EUF-1	Develop a standardized philosophy for pricing programs and services that reflects the Wake Forest community			
POLICIES FOR PURSUING GRANTS		**YES**	**NO**	**NA**
PG-1	Continue to research, submit, and track federal, regional, state, and local grants			
POLICIES FOR IMPLEMENTING PARKS, RECREATION, AND GREENWAYS		**YES**	**NO**	**NA**
PRG-1	Develop a plan for the implementation of the Parks, Recreation, and Greenways Improvements from the 2014 Bond Referendum			
POLICIES FOR INCREASING TAX INCREMENT LEVELS		**YES**	**NO**	**NA**
ITIL-1	Campaign for community investment in long term Master Plan implementation			
POLICIES FOR INCREASING PROGRAMMING FOR FAMILIES, SENIORS, AND TEENS		**YES**	**NO**	**NA**
PFST-1	Expand program opportunities for teens, families, and seniors in all locations			
POLICIES FOR INCREASING PROGRAMS IN WELLNESS, CULTURAL, AND SPECIAL NEEDS		**YES**	**NO**	**NA**
WCSN-1	Expand wellness/fitness, cultural, and special needs programming opportunities			
WCSN-2	As new facilities are developed and constructed, include appropriate spaces for wellness/fitness, cultural, special needs, and aquatic opportunities			
POLICIES FOR INCREASING THE NUMBER OF SPECIAL EVENTS AND FESTIVALS		**YES**	**NO**	**NA**
OC-1	Expand neighborhood and community special event and festival opportunities at a variety of locations community wide with an emphasis in the downtown area			
POLICIES FOR CREATING INCREASED PARTICIPATION AT THE RENAISSANCE CENTER		**YES**	**NO**	**NA**
APRC-1	Create a 3 to 5-year Strategic Plan that focuses on creating awareness and increasing programming, and develop a marketing strategy			
POLICIES FOR CREATING GREATER AWARENESS FOR THE URBAN FORESTY DIVISION		**YES**	**NO**	**NA**
AUFD-1	Develop a marketing strategy for the Urban Forestry Division that creates a greater awareness and public interest in the goals and outcomes of the Division			
AUFD-2	Develop implementation strategies and educational opportunities for the Urban Forestry Management Plan			
POLICIES FOR MAINTAING AND IMPROVING EXISTING FACILITIES		**YES**	**NO**	**NA**
AUFD-1	Continue to implement maintenance strategies that both sustain and make improvements to existing facilities			
AUFD-2	Develop a plan to address the recommendations from the inventory as they relate to individual park improvements			

Parks & Recreation Master Plan Consistency Grid				
POLICIES FOR EXPANDING TRAILS AND CONNECTIVITY		**YES**	**NO**	**NA**
AUFD-1	Complete Greenways System as identified in the 2014 Bond			
AUFD-2	Explore the development of trail heads at entrance points to the Greenway			
POLICIES FOR PROVIDING NEW FACILITIES		**YES**	**NO**	**NA**
PNF-1	Explore the opportunity to design and construct a 65,000 square foot Recreation Center in the downtown area that includes a competitive pool, water features, gymnasiums, fitness/wellness space, indoor track, and community space			
PNF-2	Explore the opportunity to construct a dedicated Pickleball facility that could serve the region as a tournament and league play hub			

Comprehensive Transportation Plan Consistency Grid

POLICIES FOR GENERAL RECOMMENDATIONS		YES	NO	NA
GR-1	Update the CTP annually to capture changes in existing conditions, development, Capital Improvement Plan (CIP), and transportation regulations			
GR-2	Continue coordination with CAMPO, Wake County, NCDOT, and other local and regional partners, as appropriate, on infrastructure improvements			
GR-3	Study the Town Historic Districts and Northeast Community to determine if alternative curb/gutter and sidewalk cross-sections are needed			
GR-4	Update the CTP to capture any transportation recommendations from the CAMPO North East Area Study			
GR-5	Update the CTP to capture any transportation recommendations from the Northeast Community Plan			
GR-6	Update the CTP to capture any transportation recommendations from the Wake Forest Community Plan Update			
GR-7	Continue to support public private partnerships for infrastructure projects			

POLICIES FOR RAIL RECOMMENDATIONS		YES	NO	NA
RR-1	Continue coordination with CAMPO, NCDOT, and other local and regional partners, as appropriate, for the advancement of the Southeastern High-Speed Rail or S-Line			
RR-2	Develop TOD small area plans for the station areas			

POLICIES FOR BUS RECOMMENDATIONS		YES	NO	NA
BR-1	Implement Loop B of the Wake Forest Loop bus service			
BR-2	Develop an interactive website for the Wake Forest Loop showing stop location and bus station infrastructure			
BR-3	Explore real time technology options to enhance user experience			
BR-4	Develop a plan to introduce public art into bus shelter design			
BR-5	Explore wayfinding opportunities at bus shelter locations			
BR-6	Develop standardized street furniture and shelter for bus stop locations that are either purchased by the Town or donated by private citizens or groups			
BR-7	Continue coordination with CAMPO, Wake County, Wake Transit, and other local and regional partners, as appropriate, for the advancement of transit in the region			
BR-8	Continue to support fare free bus transit in Wake Forest			
BR-9	Evaluate the Unified Development Ordinance (UDO) for bus stop design standards during site plan review			
BR-10	Implement the CIP bus shelter program to add additional bus shelters annually along the Wake Forest Loop			

POLICIES FOR EMERGING TECHNOLOGIES		YES	NO	NA
ET-1	Develop a plan to optimize the Town's investment in electric vehicle charging infrastructure and identify opportunities to install charging infrastructure			
ET-2	Update the UDO to reflect electric vehicle charging technology and analyze options for incorporating electric vehicle readiness into development regulations			
ET-3	Explore Intelligent Transportation Systems (ITS) and emerging technologies and evaluate their integration into the transportation system			
ET-4	Explore signal integration with regional partners			
ET-5	Consider future impacts of autonomous vehicles on development regulations			
ET-6	Evaluate micro-transit technology as an option for public transportation			

Comprehensive Transportation Plan Consistency Grid

POLICIES FOR PEDESTRIAN RECOMMENDATIONS		YES	NO	NA
PR-1	Support Safe Routes to School events at local Wake Forest schools and explore additional opportunities for safety events			
PR-2	Update the UDO to reflect greenway design and multi-use path design			
PR-3	Develop an inventory of ADA accessible crosswalks and pedestrian ramps and develop an action plan to bring substandard infrastructure into compliance			
PR-4	Develop an updated interactive website for the greenway network			
PR-5	Develop a standard operating procedure for greenway sign locations that as part of the development review process			
PR-6	Expand existing GIS data along greenways to ensure signage, emergency locations, benches, and other amenities have been captured			
PR-7	Expand pedestrian connectivity standards in the UDO for block length and at the ends of cul-de-sacs			
PR-8	Continue to support the funding of sidewalk gaps with Town funding			
PR-9	Evaluate the proposed bicycle network and update proposals after investigating need and if roadways can accommodate proposals			
PR-10	Evaluate all unsignalized greenway trail crossing to determine whether crossing enhancements would be appropriate			
PR-11	Explore grant opportunities such as CDBG funding for improvements in marginalized neighborhoods			
PR-12	Continue coordination with CAMPO, Wake County, NCDOT, and other local and regional partners, as appropriate, on infrastructure improvements and funding sources, such as LAPP			
PR-13	Update pedestrian signage to be interpretive to meet ADA requirements			
PR-14	Support Wake Forest bicycle safety events and explore additional opportunities			
PR-15	Evaluate the use of soft trails and paved surfaces in the development of the Wake Forest Reservoir master plan while ensuring residents with varying ability level access to the reservoir			
PR-16	Evaluate the Town-owned 80 acres behind Heritage High School for any deed restrictions that limit development of the Smith Creek Greenway and neighborhood connections thereto			
PR-17	Evaluate off-street bikeway cross-sections where bicycle infrastructure is out of the roadway and running parallel to the curb			
PR-18	Explore reintroducing bike share as a mode of transportation for the Town			

POLICIES FOR ROADWAY RECOMMENDATIONS		YES	NO	NA
RWR-1	Fund the South Main Street study for access management along South Main Street between US 1 and South Avenue			
RWR-2	Update the UDO access management standards			
RWR-3	Explore the potential for a roundabout at Ligon Mill Road and Burlington Mill Road			
RWR-4	Evaluate the UDO language to examine street connectivity standards during development review			
RWR-5	Evaluate the UDO language to examine street connectivity standards to promote an organic local street network			
RWR-6	Update UDO based on the roadway classifications and remove roadway cross-sections in the UDO			
RWR-7	Work with regional partners to advocate for accelerating the US 1 Project			
RWR-8	Update the UDO to add regulations to match Wake County on how to handle cemeteries in development and roadway projects			

Public Arts Plan Consistency Grid

POLICIES FOR PUBLIC ARTS IMPLEMENTATION		YES	NO	NA
PAI-1	Liason and consult with municipal agencies and departments			
PAI-2	Commission orignal works of public art			
PAI-3	Acquire public art			
PAI-4	Document all accession, deaccession, loans, or donations of public art			
PAI-5	Provide technical feasibility for public art			
PAI-6	Ensure public art commissioned by the Town is owned by the Town			
PAI-7	Ensure the deaccession of public art is handled with cautious, deliberate and scrupulous standards			
PAI-8	Ensure public art emphasizes placemaking with safety, security, maintenance, accessibility, context, departmental support and community support in mind			
PAI-9	Actively engage an artist when undertaking Town capital projects and encourage private developers to include either an artist on the design team or works of art with public access within the development			
PAI-10	Explore incentives for public art such as tax credits, covering maintenance costs and payment-in-lieu to locate artwork on an alternative site			
PAI-11	Consider easements for public art			
PAI-12	Ensure adequate maintenance is performed on public art			
PAI-13	Avoid conflicts of interest in the selection of a project site, finalist or artist			

Historic Preservation Plan Consistency Grid

POLICIES FOR HISTORIC PRESERVATION		YES	NO	NA
HP-1	Ensure that historic preservation education includes a special emphasis on local history and architecture, the Historic District Design Guidelines, and preservation methods and techniques			
HP-2	Utilize communitcation tools, working closely with the Town's Communications Department and partnering with the news media, to get the word out about historic preservation			
HP-3	Continue important historic preservation programs, including property designation and listing, protecting endangered properties, incentive programs, and the enforcement of the Historic District Design Guidelines			
HP-4	Encourage physical Improvements in historic neighborhoods, including pedestrian lighting, sidewalk improvements, and street Improvements			
HP-5	Encourage special projects in historic preservation, including Town policies in support of historic preservation, the protection of the Ailey Young House, and the development of an interactive data base			
HP-6	Encourage special events focused on historic preservation, including the biennial Christmas Historic Home Tour, other guided historic tours, and a Historic Home and Garden Tour			

POLICIES FOR ARTS CULTURE AND HISTORIC PRESERVATION (Copied from Community Plan and ad		YES	NO	NA
ACH-5	Employ design standards that ensure development and redevelopment is consistent with the architectural context, community character, economic attractiveness and livability of Wake Forest			
ACH-6	Encourage the identification, restoration, and active use of structures, buildings, monuments, landmarks, sites and neighborhoods of historic or architectural significance			
ACH-7	Strongly discourage the destruction of architectural, historic, and archealogical resources of Wake Forest			

TOWN *of*
WAKE FOREST

Report Requirements:

Per NCGS 160D-604, all proposed amendments to the zoning ordinance or zoning map shall have a written report provided from the Planning Board to the Board of Commissioners within 30 days of referral of the amendment to the Planning Board, or the Board of Commissioners may proceed in its consideration of the amendment without the Planning Board report. Furthermore, in no case is the Board of Commissioners bound by the recommendations, if any, of the Planning Board.

Per NCGS 160D-604, the Planning Board shall advise and comment on whether the proposed zoning amendment is consistent with all applicable officially adopted plans, and provide a written recommendation to the Board of Commissioners that addresses plan consistency and other matters as deemed appropriate by the Planning Board, but a comment by the Planning Board that a proposed amendment is inconsistent with the officially adopted plans shall not preclude consideration or approval of the proposed amendment by the Board of Commissioners.

GENERAL INFORMATION

Applicant: Town of Wake Forest

Owner: N/A

Requested Action: Amendment to Chapters 2, 7, 9, 15, and Appendix B of the UDO.

Existing Zoning: N/A

Location: N/A

Size: N/A

Tax PINs: N/A

Existing Land Use: N/A

Applicable Officially Adopted Plans:

The request is generally Consistent with the relevant policies in the Comprehensive Plan, and Approval of the zoning map and zoning overlay map request is reasonable and in the public interest. See Attachment for a detailed Plan Consistency Analysis.

This report reflects the recommendation of the Planning Board, this the 31st day of January 2022.

Introduced by Planning Board member: Thomas Ballman

Seconded by Planning Board member: Chris Joyner

Attest:

Joe Kimray
Planning Board Chair

Courtney Tanner
Planning Director

2. District Provisions

2.1. OFFICIAL ZONING MAP

2.1.1. ZONING MAP

A. Zoning Districts

The boundaries of each zoning district are shown on a map entitled "Town of Wake Forest Official Zoning Map" which is hereby made a portion of this ordinance. The Official Zoning Map shall bear the adoption date of this ordinance and the signatures of the Mayor and Town Clerk.

B. Overlay Districts

Certain overlay districts such as the Special Highway Overlay District, the Watershed Protection Districts, etc., are hereby established and incorporated by reference. The spatial data for such overlay(s) shall be presented with the Official Zoning Map as appropriate.

C. Administration and Maintenance of Zoning Map

The Official Zoning Map shall be maintained in the Wake Forest Planning Department and a copy shall be kept on file with the Town Clerk. The Administrator shall separately maintain the digital files that comprise the map and record all map amendments in a separate metadata file.

2.1.2. INTERPRETATION OF BOUNDARIES

When uncertainty exists with respect to the boundaries or districts as shown on the Official Zoning Map, the following rules shall apply:

A. District boundary lines are generally intended to be along or parallel to property lines, lot lines, the center line of street, alleys, railroads, easements, other rights-of-way, and creeks, streams, or other water channels.

B. In the absence of specified distances on the map, dimensions or distances shall be determined by the scale of the Official Zoning Map.

C. Where the Zoning Map shows a district boundary dividing a lot, each part of the lot shall conform to the standards established by this ordinance for the land development or overlay district in which that part is located.

D. When the street or property layout existing on the ground is at variance with that shown on the Official Zoning Map, the Planning Board shall interpret the district boundaries of this ordinance in accordance with Section 14.4

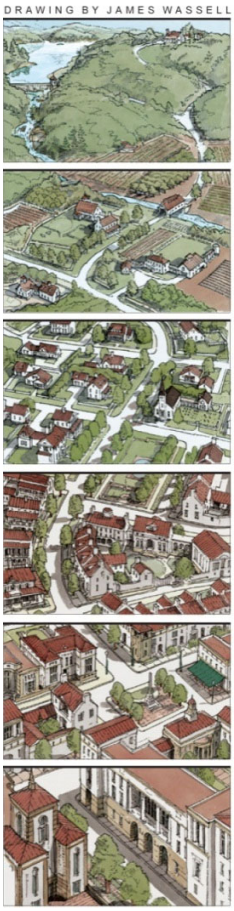
2.2. DISTRICT PROVISIONS

2.2.1. Urban (Form-Based) Districts General Overview

A number of the key districts for the Town of Wake Forest are ordered and classified according to the Rural-Urban Transect. The Transect is a method of classifying the natural and built environments as a continuum of six conditions, ranging from rural to urban. The value of the Transect is that it classifies development form with the appropriate land use and development context. For example, a rural street typically has no curbs or sidewalks and its buildings are often irregularly spaced. An urban street, depending on the intensity of urbanism, may have curbs and gutters, regularly placed street trees, sidewalks, and building forms that are more regular in form and spacing. Each urban zoning category has detailed provisions for the mix of uses, building type,

density, height, street design, the design of parks and open space, the mix of uses, building design, parking, streetscape and other aspects of the human environment.

In order to implement the intent of this ordinance, there are hereby created several base districts with the designations and general purposes listed under each and the specifically permitted uses, special uses, dimensional standards and permitted building types included. Each base district has a corresponding Conditional District designation which shall be administered in accordance with Section 2.6.



A. Natural & Rural Areas

The Transect begins with two areas that are rural in character: the Natural Area, which is made up of lands protected in perpetuity as natural, recreational or agricultural areas; and the Rural Area, which includes areas of high agricultural, scenic, or environmental value that should be protected.

B. Suburban Area

The transition area between countryside and town is called the Suburban Area. This area consists primarily of single family homes. Although this area is primarily a residential area, it may have other development types, such as schools and other civic uses.

C. General Urban Area

General Urban development is primarily residential, but more urban in character, having a higher density with a mix of housing types and a greater mix of uses, including neighborhood-serving commercial uses.

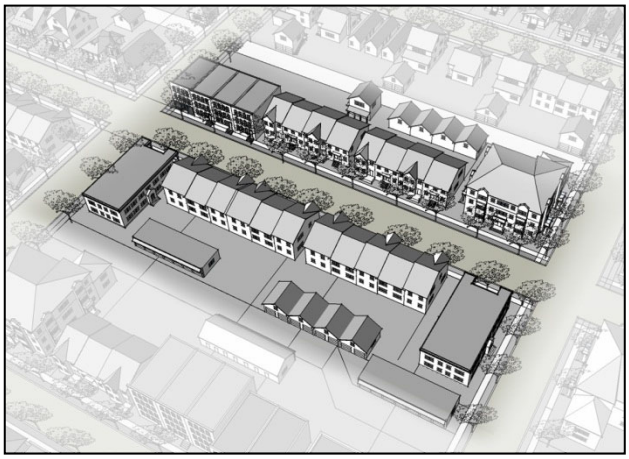
D. Urban Center Area

At the more urban end of the spectrum is the Urban Center Area. This can be a small neighborhood center or a larger Village/Town center, the latter serving more than one neighborhood.

E. Urban Core Area

The Urban Core or Downtown serves not only adjacent neighborhoods, but the entire town and the region. While it is typically the central business district where the greatest mix of uses occurs, the historic character and location of Wake Forest's downtown is too small in size and scale to serve as a primary urban core area.

2.2.2. Urban District Descriptions

BASE DISTRICT DESCRIPTION	
A. Urban Residential (UR) *Previous District(s): R10 & R8 in urban contexts* The Urban Residential District is established as a predominately residential district in which a variety of types of housing is permitted, including single-family and duplex residences, small apartment buildings and townhouses.	
B. Residential Mixed-Use (RMX) Previous District(s): R5 & O-I in urban contexts, MF, RA-C The Residential Mixed-Use District is established to accommodate a variety of housing types in a neighborhood setting. The regulations of this district are intended to provide areas of the community for those persons desiring small residences and multifamily structures in relatively high density neighborhoods within walking or biking distance from mixed-use centers as well as some limited commercial uses in pedestrian-scaled, residential-style structures.	
C. Neighborhood Mixed-Use (NMX) *Previous District(s): O-I & NB in urban contexts, RA-C* The Neighborhood Mixed-Use District is established as a pedestrian-scaled, mixed-use district which caters to the everyday needs of nearby neighborhoods, stressing accessibility by automobiles, bicycles, and pedestrians.	

BASE DISTRICT DESCRIPTION	
D. Renaissance Area Historic Core (RA-HC) The Historic Core of the Renaissance Area permits the sensitive continuation of the "Main Street" environment of White Street and its secondary streets. The ground floor of buildings on White Street should be comprised of active uses including retail or restaurants with office and residential located on second stories. Side streets east of White Street may have a greater variety of ground floor uses.	
E. Urban Mixed-Use (UMX) *Previous District(s): RA-UC* The Urban Mixed-Use District accommodates an active, pedestrian-friendly area of community-scale commercial, residential, office, and civic uses in both vertically mixed-use, as well as free-standing buildings. Retail should be placed at street level, with residential uses in rear or upper stories.	
F. Planned Unit Development (PUD) The Planned Unit Development (PUD) district is designed to promote a compatible mix of uses to instigate an integrated and sustainable development consistent with the Town's unique character. This district shall also encourage design flexibility; multi-modal connectivity between uses; sensitivity to natural resources and environmental features; and facilitate the efficient provisions of infrastructure, utilities and adequate public facilities.	

2.2.3. Table of Urban District Development Standard

Base Districts	UR	RMX	NMX RA-HC	UMX	PUD
A. BUILDING TYPE (Section 5.4 – 5.8)	Civic / Institutional Detached House Townhouse	Civic / Institutional Detached House Townhouse Apartment Commercial	Civic / Institutional Townhouse Apartment Commercial	Civic / Institutional Townhouse Apartment Commercial	Civic / Institutional Detached House Townhouse Apartment Commercial
B. PRIVATE FRONTAGE (Section 5.3)					Refer to Section 2.7
1. Common Lawn	Permitted	Permitted	Prohibited	Prohibited	--
2. Porch & Fence	Permitted	Permitted	Prohibited	Prohibited	--
3. Terrace or Light Court	Permitted	Permitted	Permitted	Permitted	--
4. Forecourt	Permitted	Permitted	Permitted	Permitted	--
5. Stoop	Permitted	Permitted	Permitted	Permitted	--
6. Shopfront/Awning	Prohibited	Permitted	Permitted	Permitted	--
7. Gallery	Prohibited	Prohibited	Permitted	Permitted	--
8. Arcade	Prohibited	Prohibited	Permitted	Permitted	--
C. DEVELOPMENT STANDARDS					
1. Max. Density *(Units/Acre)*	10 dua	24 dua	n/a	n/a	n/a
2. Open Space (min) per CH 7	5%	5%	2% for projects 5 acres or greater	2% for projects 5 acres or greater	15%
3. Park Space (min) per CH 7	2%	2%	2% for projects 5 acres or greater	2% for projects 5 acres or greater	2%
4. Minimum and Maximum Development Size if not in TND	80 acres maximum	40 acres maximum	n/a	n/a	10 acres minimum
D. PRINCIPAL BUILDING					
1. Principal Front Setback	20 ft max.	18 ft max.	12 ft max (NMX) 5 ft max. (RA-HC)	6 ft max.	Per UDO Section 2.7
2. Street Side/Secondary Front Setback	5 ft min.	5 ft min.	12 ft max.	6 ft max.	Per UDO Section 2.7
3. Side (from adjacent lot) Setback[1,2]	5 ft min.	0 ft min.	0 ft min.	0 ft min.	Per UDO Section 2.7
4. Rear Setback	20 ft min. OR 5ft min. w/ rear alley access	5 ft min.	0 ft min.	0 ft min.	Per UDO Section 2.7
5. Frontage Buildout[3]	n/a	n/a	60% min.	70% min.	Per UDO Section 2.7

Base Districts	UR	RMX	NMX RA-HC	UMX	PUD
E. ACCESSORY STRUCTURE					
1. Side Setback[1]	5 ft min.	5 ft min. OR 0 ft min. for attached structures	5 ft min. OR 0 ft min. for attached structures	0 ft min.	Per UDO Section 2.7
2. Rear Setback[1]	5 ft min.	5 ft min.	5 ft min.	0 ft min.	Per UDO Section 2.7
3. Garage Setback from Alley	15 ft from face of garage to centerline of alley				
4. Other Standards	20 ft min. behind building frontage line		Rear Yard Only		
F. PARKING CONFIGURATION					
1. Parking Requirements	By Use - See Section 9.4				
2. Parking Location	By Building Type - See Section 9.3				
G. HEIGHT					
1. Min. Height	None	None	16 ft	2 stories	Per UDO Section 2.7
2. Max. Height[4]	3 stories	6 Stories (May Exceed with an SUP)	6 Stories (May Exceed with an SUP) (3 Stories along White Street from Elm to Roosevelt)	6 Stories (May Exceed with an SUP)	6 Stories or 60 feet, whichever is less (may exceed with an SUP)

[1] *May be increased subject to building code standards*
[2] *Side setback does not apply to interior units of townhome buildings*
[3] *For primary street frontage only; see Section 4.3.3.C for calculations*
[4] *When maximum height is express in stories, the allowable height shall be calculated by multiplying the maximum number of stories permitted by the maximum story height outlined in Section 4.5.*

2.2.4. Rural and Suburban Districts

In order to maintain existing auto-oriented commercial and industrial areas, and conventionally developed residential subdivisions, there are hereby continued several base districts with the designations and general purposes listed under each and the specifically permitted uses, special uses, and dimensional standards included. It is expected that the expansion or enlargement of these districts will be minimal as more than sufficient area currently exists in accordance with the adopted Community Plan for such single-use categories. Each base district has a corresponding Conditional District designation which shall be administered in accordance with Section 2.4.

BASE DISTRICT	DESCRIPTION
A. Open Space District (OS)	The Open Space District is established to preserve and protect environmentally sensitive lands (e.g. floodways, wetlands) and properties that are already under public ownership and/or otherwise restricted for use for passive or active recreational use.

BASE DISTRICT	DESCRIPTION
B. Rural Holding District (RD) *Previous District(s): RD*	The Rural Holding District is established as a district in which the principal uses of the land are restricted due to lack of available utilities, unsuitable soil types or steep slopes.
C. General Residential (GR3, GR5, GR10) *Previous District(s): R20, R15, R10, R5, MF, O-I* *R-20 & R-15 convert to GR3* *R-10 converts to GR5* *R-5, MF & O-I convert to GR10 where applicable*	The General Residential Districts are established to maintain previously developed suburban residential subdivisions for their existing or approved low-to-medium density single-family dwellings and related recreational, religious and educational facilities. Intended to act as a transitional zoning district between rural development in the county and the urban development of the town, these regulations are further intended to discourage any use which would be detrimental to the predominately residential nature of the areas included within the district.
D. Neighborhood Business (NB) *Previous District(s): NB, O-I*	The Neighborhood Business District is established as a district in which the principle use of land is for retail trade and services purposes of a lower intensity than the Highway Business (HB) District. Such districts are generally located near residential areas and cater to the everyday needs of nearby residential neighborhoods, stressing accessibility by automobiles, bicycles, and pedestrians.
E. Highway Business (HB) *Previous District(s): HB*	The Highway Business District is generally located on the major thoroughfares in town and provides opportunities for the provision of offices, services and retail goods. The regulations for this district are intended to accommodate the predominately auto-oriented pattern of existing development while encouraging the creation of new pedestrian-friendly, mixed-use areas that avoid strip commercial development and establish more resilient land development patterns.
F. Institutional Campus Development (ICD) *Previous District(s): ICD*	This district is intended to allow for the continued and future use, expansion, and new development of academic and religious campuses and of governmental and health facilities, where the campus or facility has a total development size greater than 10 acres. The goal is to promote the many varied uses associated with such institutions while maintaining the overall design integrity of the campus setting and minimizing any adverse impacts on the neighboring residential and historic areas. In the attempt to meet this goal numerous requirements are included, such as but not limited to buffers, landscaping, outdoor lighting, parking, signage, building height, setbacks, and the like.
G. Light Industrial (LI) *Previous District(s): I*	The Light Industrial District is established to accommodate externally benign industrial and office uses that pose little nuisance to adjacent residential or mixed-use areas.
H. Heavy Industrial (HI)	The Heavy Industrial District is established to accommodate those industrial, manufacturing, or large-scale utility operations that are known to pose levels of noise, vibration, odor, or truck traffic that are considered nuisances to surrounding development.

2.2.5. Table of Rural and Suburban District Development Standards

Standard	Open Space (OS)	Rural Holding District (RD)	General Residential (GR3, GR5, GR10)	Neighborhood Business (NB)	Highway Business (HB)	Institutional Campus Development (ICD)	Light Industrial (LI)	Heavy Industrial (HI)
A. DEVELOPMENT STANDARDS								
1. District/Development Area (min)	n/a	n/a	n/a	n/a	n/a	10 acres	10 acres	20 acres
2. Density (max)[1]	n/a	1 unit/acre	GR3: 3 units/acre GR5: 5 units/acre GR10: 10 units/acre	n/a	n/a	determined by adopted master plan	n/a	n/a
3. Open Space (min) per Chapter 7	n/a	10%	10%	n/a	n/a	25%	n/a	n/a
4. Park Space (min) per Chapter 7	n/a	2.5%	2.5%	n/a	n/a	n/a	n/a	n/a
5. Building Floor Area (Max)	n/a	n/a	n/a	50,000 sq ft per building	n/a	n/a	n/a	n/a
6. Development Floor Area (Max)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
B. LOT STANDARDS								
1. Lot Area (min)[2]	n/a	40,000 sq ft	GR3: 10,000 sq ft GR5: 7,500 sq ft GR10: 5,000 sq ft	None except max. 15 acres for Shopping Centers	20,000 sf	n/a	40,000 sq ft (interior lots only)	5 acres (interior lots only)
2. Lot Width at Front Setback (min)[3]	n/a	60 ft	50 ft	none	150 ft	n/a	n/a	n/a
C. PRINCIPAL BUILDING								
1. Principal Front Setback (min)	20 ft	20 ft	20 ft	20 ft	30 ft	20 ft	30 ft	50 ft
2. Street Side/Secondary Front Setback (min)	20 ft	20 ft	20 ft	20 ft	30 ft	20 ft	30 ft	50 ft
3. Side (from adjacent lot) Setback (min)[4]	10 ft	10 ft	8 ft	15 ft	10 ft	10 ft	15 ft	30 ft
4. Rear Setback (min)	25 ft	25 ft	25 ft	20 ft	30 ft	20 ft	20 ft	50 ft
D. ACCESSORY STRUCTURE								
1. Side Setback (min)	10 ft	10 ft	5 ft	10 ft	10 ft	10 ft	10 ft	10 ft
2. Rear Setback (min)	10 ft	10 ft	10 ft	10 ft	10 ft	10 ft	10 ft	10 ft
3. Other Standards	n/a	See Section 4.6	See Section 4.6	See Section 4.6	See Section 4.6	See Section 4.6	See Section 4.6	See Section 4.6
E. PARKING CONFIGURATION								
1. Parking Location		By Building Type - See Section 9.3						
2. Specific Restrictions	n/a	n/a	n/a	Parking in Front setback not permitted	Parking in first 10 ft of Front setback	Parking in Exterior setback not permitted except as part	Parking in Front & Exterior setback not permitted	Parking in Exterior setback not permitted

Standard	Open Space (OS)	Rural Holding District (RD)	General Residential (GR3, GR5, GR10)	Neighborhood Business (NB)	Highway Business (HB)	Institutional Campus Development (ICD)	Light Industrial (LI)	Heavy Industrial (HI)
					not permitted	of an approved CD plan		
F. BUILDING HEIGHT								
1. Principal Building (max)	n/a	35 ft	3 stories	3 stories	3 stories	35 ft	50 ft	50 ft
2. Accessory Structure (max)	n/a	35 ft	2 stories	2 stories	2 stories	35 ft	35 ft	35 ft
3. Additional Height Permitted w/Additional Setback	n/a	n/a	n/a	n/a	90 ft height permitted in US-1 Corridor Area (Subject to SUP)	1 ft additional height permitted with each 1 ft horizontal setback beyond the minimum up to a 20 ft increase in allowable height	1 ft additional height permitted with each 1 ft horizontal setback beyond the minimum up to a 20 ft increase in allowable height	1 ft additional height permitted with each 1 ft horizontal setback beyond the minimum setback up to a 20 ft increase in allowable height

[1] Subject to the provisions of the Water Supply Watershed Protection Overlay Districts (where applicable).
[2] For townhomes this standard applies to the entire townhome development, not individual townhome lots. Different requirements may apply if located in a Special Highway Overlay (SH1-O and SH2-O) District.
[3] For townhomes this standard applies to the entire townhome development, not individual townhome lots. Different requirements may apply if located in a Special Highway Overlay (SH1-O and SH2-O) District.
[4] May be increased subject to building code standards.

2.3. Uses Permitted

2.3.1. Use Categories

All uses permitted in the UDO have been divided into 10 categories, defined as follows:

A. **Residential:** Premises available for long-term human habitation by means of ownership and rental, excluding short-term leasing or rental of less than 1 month.

B. **Lodging:** Premises available for short-term human habitation, including daily and weekly rental.

C. **Office/Service:** Premises available for the transaction of general business and the provision of services, but excluding retail sales and manufacturing, except as a minority component.

D. **Commercial/Entertainment:** Premises available for the commercial sale of merchandise, prepared foods, and food and drink consumption, but excluding manufacturing.

E. **Civic:** Premises available for organizations dedicated to religion, government, arts and culture, recreation and sports, and other similar areas of public assembly.

F. **Educational/Institutional:** Uses and premises dedicated to education, social service, health care, and other similar functions.

G. **Automotive:** Uses and premises accessed predominately by or dedicated to the sale, maintenance, servicing and/or storage of automobiles or similar vehicles.

H. **Industry/Wholesale/Storage:** Premises available for the creation, assemblage, storage, and repair of items including their wholesale or retail sale.

I. **Agricultural:** Premises for growing crops, raising animals, harvesting timber, and harvesting fish and other animals from a farm, ranch or their natural habitat and all related functions.

J. **Infrastructure:** Uses and structures dedicated to transportation, communication, information, and utilities.

2.3.2. Interpretation of Use Table

A. **Permitted/Prohibited Uses:** Uses not listed as permitted (P); permitted with additional supplemental standards (Ps); or requiring a special use permit (SUP) are presumed to be prohibited (-) from the applicable zoning district. Uses denoted with (CZ) indicate that a conditional zoning is required for the use to be considered in the parallel Conditional District. Uses denoted with (A) indicate only permitted as an accessory use.

B. **Uses Not Listed:** In the event that a particular use is not listed in the Use Table, and such use is not listed as a prohibited use and is not otherwise prohibited by law, the Administrator shall determine whether a materially similar use exists in this chapter. Should the Administrator determine that a materially similar use does exist, the regulations governing that use shall apply to the particular use not listed and the Administrator's decision shall be recorded in writing. Should the Administrator determine that a materially similar use does not exist, this chapter may be amended to establish a specific listing for the use in question.

C. **Materially Similar Uses:** The Administrator may determine that a use is materially similar if a permitted use is similarly classified by one or more of the following use classification systems:

1. American Planning Association Land-Based Classification Standards (LBCS)
2. North American Industrial Classification System (NAICS)
3. Institute of Transportation Engineers (ITS) Trip Generation Guide

2.3.3. Use Table

See **Error! Reference source not found.** – **Error! Reference source not found.** for more information regarding how the development process will be administered according to the use allowances established below. See Chapter 15 for procedures on application types and approval processes.

(P)=Permitted
(SUP)=Permitted with Approval of Special Use Permit
(CZ)=Permitted with Approval of Conditional Zoning
(A)=Permitted only as an Accessory Use
(s)=Supplemental Use Standards

	RURAL		SUBURBAN								URBAN					
USE TYPES	**OS**	**RD**	**GR3**	**GR5**	**GR10**	**NB**	**HB**	**ICD**	**LI**	**HI**	**UR**	**RMX**	**RA-HC**	**NMX**	**UMX**	**PUD**

A. RESIDENTIAL	**OS**	**RD**	**GR3**	**GR5**	**GR10**	**NB**	**HB**	**ICD**	**LI**	**HI**	**UR**	**RMX**	**RA-HC**	**NMX**	**UMX**	**PUD**
HOUSEHOLD LIVING USES																
Dwelling-Single Family	–	P	P	P	P	–	–	P	–	–	P	Ps	–	–	–	P
Dwelling-Duplex	–	–	–	P	P	–	–	P	–	–	P	Ps	–	–	–	P
Dwelling-Townhome	–	–	–	–	P	–	–	P	–	–	P	Ps	P	Ps	P	P
Dwelling-Multifamily	–	–	–	–	P	–	–	P	–	–	Ps	Ps	P	Ps	P	P

	RURAL		SUBURBAN								URBAN					
USE TYPES	**OS**	**RD**	**GR3**	**GR5**	**GR10**	**NB**	**HB**	**ICD**	**LI**	**HI**	**UR**	**RMX**	**RA-HC**	**NMX**	**UMX**	**PUD**
Dwelling-Accessory	–	As	As	As	As	–	–	As	–	–	As	As	As	As	As	As
Family Care Home (6 or fewer residents)	–	Ps	Ps	Ps	Ps	Ps	–	Ps	–	–	Ps	Ps	Ps	Ps	Ps	Ps
Live-Work Unit	–	–	–	–	Ps	P	P	Ps	–	–	Ps	Ps	Ps	P	P	P
Manufactured Housing – Class A	–	Ps	–	Ps	Ps	–	–	–	–	–	SUPs	–	–	–	–	–
Manufactured Housing – Class B & C	–	SUPs	–	SUPs	SUPs	–	–	–	–	–	–	–	–	–	–	–
Manufactured Home Park	–	SUPs	–	–	–	–	–	–	–	–	–	–	–	–	–	–
GROUP LIVING USES																
Boarding or Rooming House (12 or fewer persons)	–	–	Ps	Ps	–	Ps	–	Ps	–	–	Ps	Ps	Ps	Ps	Ps	–
Dormitory	–	–	–	–	–	–	–	P	–	–	–	–	–	–	–	P
Residential Care Facility (More than 6 Residents)	–	–	Ps	Ps	Ps	Ps	–	Ps	–	–	Ps	Ps	Ps	Ps	Ps	Ps

B. LODGING	**OS**	**RD**	**GR3**	**GR5**	**GR10**	**NB**	**HB**	**ICD**	**LI**	**HI**	**UR**	**RMX**	**RA-HC**	**NMX**	**UMX**	**PUD**
Bed and Breakfast Home (Up to 8 Rooms)	–	SUPs	SUPs	SUPs	–	–	–	Ps	–	–	SUPs	Ps	Ps	Ps	Ps	–
Hotel/Inn (Less than 20 Rooms)	–	–	–	–	SUP	P	P	P	–	–	–	P	P	P	P	P
Hotel/Inn (No Room Limit)	–	–	–	–	–	P	P	P	–	–	–	–	P	P	P	P

C. OFFICE/SERVICE	**OS**	**RD**	**GR3**	**GR5**	**GR10**	**NB**	**HB**	**ICD**	**LI**	**HI**	**UR**	**RMX**	**RA-HC**	**NMX**	**UMX**	**PUD**
ATM	–	–	–	–	–	P	P	P	P	P	–	P	P	P	P	P
Banks, Credit Unions, Financial Services	–	–	–	–	–	P	P	P	–	–	–	P	P	P	P	P
Business Support Services	–	–	–	–	–	P	P	P	P	–	–	P	P	P	P	P
Dry Cleaning & Laundry Services	–	–	–	–	–	P	P	P	–	–	–	P	P	P	P	P
Funeral Homes/Crematoria	–	P	–	–	–	P	P	–	–	–	–	P	P	P	P	–
Home Occupation	–	As	As	As	As	–	–	–	–	–	As	As	As	As	As	As
Medical Clinic	–	–	–	–	–	P	P	P	–	–	–	P	P	P	P	P
Personal Services	–	–	–	–	–	P	P	P	–	–	–	P	P	P	P	P
Personal Services, Restricted	–	–	–	–	–	–	P	–	–	–	–	–	–	–	–	–
Post Office	–	–	–	–	–	P	P	P	–	–	–	P	P	P	P	P
Professional Services	–	–	–	–	–	P	P	P	P	–	–	P	P	P	P	P
Small Equipment Repair/Rental	–	–	–	–	–	P	P	–	P	P	–	–	P	P	P	–
Veterinary Services	–	–	–	–	–	P	P	P	P	P	–	Ps	Ps	Ps	Ps	Ps

D. COMMERCIAL/ENTERTAINMENT	**OS**	**RD**	**GR3**	**GR5**	**GR10**	**NB**	**HB**	**ICD**	**LI**	**HI**	**UR**	**RMX**	**RA-HC**	**NMX**	**UMX**	**PUD**
Alcoholic Beverage Sales Store	–	–	–	–	–	P	P	–	–	–	–	P	P	P	P	P
Amusement, Indoor	–	–	–	–	–	P	P	–	P	–	–	–	P	P	P	P
Amusement, Outdoor	–	–	–	–	–	–	P	–	P	–	–	–	–	–	–	–
Bar/Tavern	–	–	–	–	–	P	P	–	–	–	–	–	P	P	P	P
General Commercial	–	–	–	–	–	P	P	P	–	–	–	P	P	P	P	P
General Commercial – Use Greater than 100,000 sf	–	–	–	–	–	–	SUP	–	–	–	–	–	–	–	–	P

	RURAL		SUBURBAN								URBAN					
USE TYPES	**OS**	**RD**	**GR3**	**GR5**	**GR10**	**NB**	**HB**	**ICD**	**LI**	**HI**	**UR**	**RMX**	**RA-HC**	**NMX**	**UMX**	**PUD**
Internet Sweepstakes Facility	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Night Club	–	–	–	–	–	P	P	–	–	–	–	–	P	P	P	P
Open Air Retail	–	–	–	–	–	Ps	Ps	SUPs	–	–	–	Ps	Ps	Ps	Ps	Ps
Outdoor Seating	–	–	–	–	–	As	As	As	–	–	–	As	As	As	As	As
Outside or Display Sales	–	–	–	–	–	As	A	As	–	–	–	As	As	As	As	As
Pawnshop	–	–	–	–	–	P	P	–	–	–	–	–	P	P	P	P
Restaurant	–	–	–	–	–	P	P	P	–	–	–	P	P	P	P	P
Riding Stable	–	P	P	–	–	–	–	–	–	–	–	–	–	–	–	–
Shooting Range, Indoor	–	–	–	–	–	–	Ps	–	–	Ps	–	–	–	–	–	–
Shooting Range, Outdoor	SUPs	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Theater, Indoor Movie or Live Performance	–	–	–	–	–	P	P	P	–	–	–	–	P	P	P	P
Theater, Outdoor	–	–	–	–	–	–	P	P	–	–	–	–	Ps	Ps	Ps	Ps

E. CIVIC	**OS**	**RD**	**GR3**	**GR5**	**GR10**	**NB**	**HB**	**ICD**	**LI**	**HI**	**UR**	**RMX**	**RA-HC**	**NMX**	**UMX**	**PUD**
Cemetery	Ps	Ps	Ps	Ps	Ps	Ps	Ps	Ps	–	–	Ps	Ps	Ps	Ps	Ps	–
Civic Meeting Facility	–	P	–	–	–	P	P	P	–	–	P	P	P	P	P	P
Community or Cultural Facility	P	P	P	P	P	P	P	P	–	–	P	P	P	P	P	P
Conference/Convention Center	–	P	–	–	–	–	P	P	–	–	–	–	–	–	P	P
Public Safety Station	–	SUP	SUP	SUP	SUP	P	P	P	P	P	P	P	P	P	P	P
Recreation Facility, Indoor	P	P	P	P	P	P	P	P	P–	–	P	P	P	P	P	P
Recreation Facility, Outdoor	P	P	P	P	P	P	P	P	–	–	P	P	P	P	P	P
Religious Institution	–	Ps	Ps	Ps	Ps	Ps	Ps	Ps	–	–	Ps	Ps	–	Ps	Ps	–
Sports Arena/Stadium	–	–	–	–	–	–	SUP	SUP	P	–	–	–	–	–	SUP	SUP

F. EDUCATIONAL/INSTITUTIONAL	**OS**	**RD**	**GR3**	**GR5**	**GR10**	**NB**	**HB**	**ICD**	**LI**	**HI**	**UR**	**RMX**	**RA-HC**	**NMX**	**UMX**	**PUD**
Child/Adult Day Care Home (8 or fewer persons)	–	As	As	As	As	–	–	–	–	–	As	As	–	As	As	As
Child/Adult Day Care Center (More than 8 persons)	–	Ps	–	–	–	Ps	Ps	Ps	–	–	–	Ps	Ps	Ps	Ps	Ps
College/University	–	–	–	–	–	–	–	P	–	–	–	–	–	–	–	SUP
Community Support Facility	–	Ps	–	–	–	Ps	P	P	–	–	Ps	Ps	Ps	Ps	SUPs	SUPs
Correctional Institution	–	–	–	–	–	–	–	–	SUPs	SUPs	–	–	–	–	–	–
Halfway Home	–	–	–	–	–	SUPs	–	–	–	–	–	SUPs	–	SUPs	–	–
Hospital	–	–	–	–	–	–	P	P	P	–	–	–	–	–	–	P
School – Elementary & Secondary	–	–	–	–	–	–	Ps	–	–	–	–	–	–	–	–	–
School – Vocational/Technical	–	–	–	–	–	–	–	P	–	–	–	P	P	P	P	P
Studio – Art, dance, martial arts, music	–	–	–	–	–	P	P	P	P	–	–	P	P	P	P	P

G. AUTOMOTIVE	**OS**	**RD**	**GR3**	**GR5**	**GR10**	**NB**	**HB**	**ICD**	**LI**	**HI**	**UR**	**RMX**	**RA-HC**	**NMX**	**UMX**	**PUD**

	RURAL		SUBURBAN								URBAN					
USE TYPES	**OS**	**RD**	**GR3**	**GR5**	**GR10**	**NB**	**HB**	**ICD**	**LI**	**HI**	**UR**	**RMX**	**RA-HC**	**NMX**	**UMX**	**PUD**
Drive-Thru/Drive-In Facility	–	–	–	–	–	Ps	Ps	–	–	–	–	–	SUPs	SUPs	SUPs	–
Gas/Fueling Station	–	–	–	–	–	Ps	Ps	–	–	–	–	–	–	SUPs	SUPs	–
Heavy Equipment/Manufactured Home Rental/Sales	–	–	–	–	–	P	P	–	P	–	–	–	–	–	–	–
Parking Lot/Structure – Principal Use	–	–	–	–	–	SUPs	SUPs	P	P	P	–	CZ	CZ	SUPs	SUPs	SUPs
Theater, Drive-In	–	–	–	–	–	–	P	–	P	–	–	–	–	–	–	–
Vehicle Rental/Leasing/Sales	–	–	–	–	–	–	P	–	P	–	–	–	–	–	–	–
Vehicle Rental – Moving Trucks	–	–	–	–	–	–	P	–	P	–	–	–	–	–	–	–
Vehicle Services – Minor Maintenance/Repair	–	–	–	–	–	Ps	P	–	P	P	–	–	–	Ps	Ps	
Vehicle Services – Major Repair/Body Work	–	–	–	–	–	–	P	–	P	P	–	–	–	–	–	–

H. INDUSTRY/WHOLESALE/STORAGE	**OS**	**RD**	**GR3**	**GR5**	**GR10**	**NB**	**HB**	**ICD**	**LI**	**HI**	**UR**	**RMX**	**RA-HC**	**NMX**	**UMX**	**PUD**
Industry, Light	–	–	–	–	–	–	Ps	–	Ps	Ps	–	–	–	–	–	–
Industry, Heavy	–	–	–	–	–	–	–	–	–	Ps	–	–	–	–	–	–
Landfill	–	–	–	–	–	–	–	–	–	SUP	–	–	–	–	–	–
Light Manufacturing Workshop	–	–	–	–	–	P	P	–	P	P	–	P	P	P	P	P
Materials Recovery & Waste Transfer Facility	–	–	–	–	–	–	–	–	SUPs	SUPs	–	–	–	–	–	–
Recycling Collection Station	–	–	–	–	–	Ps	Ps	Ps	Ps	Ps	–	–	–	–	–	–
Storage - Outdoor Storage Yard	–	–	–	–	–	–	–	–	P	P	–	–	–	–	–	–
Storage – Self-Service	–	–	–	–	–	CZ	Ps	–	P	P	–	–	–	–	–	–
Storage – Warehouse, Indoor Storage	–	–	–	–	–	–	–	–	P	P	–	–	–	–	–	P
Wholesaling and Distribution	–	–	–	–	–	–	–	–	P	P	–	–	–	–	–	P

I. AGRICULTURE	**OS**	**RD**	**GR3**	**GR5**	**GR10**	**NB**	**HB**	**ICD**	**LI**	**HI**	**UR**	**RMX**	**RA-HC**	**NMX**	**UMX**	**PUD**
Animal Production	–	SUPs	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Backyard Pen/Coop	–	As	As	As	As	As	As	As	–	–	As	As	As	As	As	As
Nursery & Garden Center	P	P	P	P	–	–	–	P	–	–	–	–	–	–	–	–
Garden (Community and Private)	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Kennel	–	SUPs	–	–	–	–	Ps	–	P	P	–	–	–	–	–	–
Produce Stand	–	Ps	Ps	Ps	Ps	Ps	Ps	Ps	–	–	Ps	Ps	Ps	Ps	Ps	Ps

J. INFRASTRUCTURE	**OS**	**RD**	**GR3**	**GR5**	**GR10**	**NB**	**HB**	**ICD**	**LI**	**HI**	**UR**	**RMX**	**RA-HC**	**NMX**	**UMX**	**PUD**
Airstrip	–	SUPs	SUPs	–	–	–	–	–	SUPs	SUPs	–	–	–	–	–	–
Wireless Telecommunications Facility (Non-Tower)	–	Ps	Ps	Ps	Ps	Ps	Ps	Ps	Ps	Ps	Ps	Ps	Ps	Ps	Ps	Ps
Wireless Telecommunications Facility (Tower)	–	SUPs	SUPs	SUPs	SUPs	SUPs	SUPs	SUPs	SUPs	SUPs	SUPs	SUPs	SUPs	SUPs	SUPs	SUPs
Utilities – Class 1	–	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Utilities – Class 2	–	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P

	RURAL		SUBURBAN								URBAN					
USE TYPES	**OS**	**RD**	**GR3**	**GR5**	**GR10**	**NB**	**HB**	**ICD**	**LI**	**HI**	**UR**	**RMX**	**RA-HC**	**NMX**	**UMX**	**PUD**
Utilities – Class 3	–	–	–	–	–	–	–	–	SUP	P	–	–	–	–	–	–

K. OTHER	**OS**	**RD**	**GR3**	**GR5**	**GR10**	**NB**	**HB**	**ICD**	**LI**	**HI**	**UR**	**RMX**	**RA-HC**	**NMX**	**UMX**	
Temporary Uses	See Section 4.7 for Specific Provisions															

2.4. Overlay Districts

For purposes of managing certain environmentally sensitive or visually important geographic areas, certain overlay districts have been established to impose design, use, or other standards in addition to the requirements of the underlying base district.

2.4.1. Overlay District Descriptions

OVERLAY DISTRICT	DESCRIPTION
A. Historic District and Landmarks Overlay (HL-O) District	In order to establish a process for designated historic districts and landmarks for the review of development applications and the maintenance of historic features in the community, the Local Historic District and Landmarks Overlay District is hereby created.
B. Special Highway Overlay (SH1-O and SH2-O)	This district is established to protect and to preserve the natural scenic beauty along major access corridors located in the Town of Wake Forest's zoning jurisdiction; and, to protect the carrying capacity of these major thoroughfares by reducing the hazards arising from unnecessary points of ingress and egress and cluttered roadside development; and, to reduce the costs of future highway expansions by protecting the associated highway corridors at the time of development. This will be achieved by requiring buildings and structures to be sufficiently set back from future rights-of-way to provide adequate storage for vehicles until they can safely enter the highway as well as additional lanes, if necessary. It is the intent of this district to ensure that development occurring in the special highway overlay district shall be in harmony with and shall preserve the natural beauty and character of the existing landscape as well as be consistent with the adopted corridor plans for US 1 and the NC-98/Dr. Calvin Jones Highway Bypass accordingly.
C. Required Shopfront (SF)	In order to implement vibrant, pedestrian-friendly areas in Form-based Districts, the Required Shopfront Overlay District has been created to ensure that the ground floor of buildings in designated blocks are designed using either Shopfront & Awning, Gallery, or Arcade private frontage.
D. Falls Lake Watershed Protection Overlay (FL-CA & FL-WMA) *Previous District(s): R-40W*	The Falls Lake Watershed Protection regulations are established as an overlay district to preserve water quality in the Falls Lake water supply watershed in order to provide safe drinking water. The intent of this district is to establish regulations which ensure the availability of public water supplies at an acceptable level of water quality for present and future residents. Two districts are hereby created: The Falls Lake-Critical Area (FL-CA) and the Falls Lake-Watershed Management Area (FL-WMA).

OVERLAY DISTRICT	DESCRIPTION
E. Richland Creek Watershed Protection Overlay (RC-CA & RC-WMA)	The Richland Creek Watershed Protection regulations are established as an overlay district to preserve water quality in the Richland Creek water supply watershed in order to provide safe drinking water. The intent of this district is to establish regulations which ensure the availability of public water supplies at an acceptable level of water quality for present and future residents. Two districts are hereby created: The Richland Creek-Critical Area (FL-CA) and the Richland Creek -Watershed Management Area (FL-WMA).
F. Smith Creek Watershed Protection Overlay (SC-CA & CA-WMA) *Previous District(s): R-80W*	The Smith Creek Watershed Protection regulations are established as an overlay district to preserve water quality in the Smith Creek/Wake Forest Reservoir water supply watershed in order to provide safe drinking water. The intent of this district is to establish regulations which ensure the availability of public water supplies at an acceptable level of water quality for present and future residents. Two districts are hereby created; Smith Creek-Critical Area (SC-CA) and the Smith Creek – Watershed Management Area (SC-WMA).
G. Little River Watershed Protection Overlay (LR-WMA)	The Little River Watershed Protection regulations are established as an overlay district to preserve water quality in the Little River water supply watershed in order to provide safe drinking water. The intent of this district is to establish regulations which ensure the availability of public water supplies at an acceptable level of water quality for present and future residents. One district is hereby created; Little River – Watershed Management Area (LR-WMA).
H. Glen Royal Mill Village Character Preservation Overlay (MVCP-O) District	This overlay district has been created in order to preserve and protect the specific historic and unique neighborhood characteristics of structures and places within the Glen Royall Mill Village National Register Historic District.

2.4.2. Historic District and Landmarks Overlay (HL-O) District

A. **Purpose**: The Historic District and Landmarks Overlay District (HL-O) is a zoning overlay district established pursuant to NC General Statutes and created with the purpose of implementing additional protections and controls on properties and structures located within locally designated Historic Districts as well as to individual Historic Landmarks.

B. **Applicability**: All locally designated Historic Districts and Historic Landmarks shall be a part of the Historic District and Landmarks Overlay District.

C. **Procedures**:

1. Designation of Historic Landmarks/Historic Districts
2. Certificate of Appropriateness – Minor Works (Minor COA)
3. Certificate of Appropriateness – Major Works (Major COA)

D. **Certificate of Appropriateness**

1. **COA Required**: No exterior feature of any building or other structure in an HL-O (including masonry walls, fences, light fixtures, utility structures, steps, pavement, signs, landscape and color or other appurtenant features), shall be erected, altered, restored, moved or demolished until after an application for a Certificate of Appropriateness has been submitted to and approved by the Historic Preservation Commission. A Certificate of Appropriateness is required to be issued by the Commission prior to the issuance of a building permit or other permit granted for the purposes of constructing, altering, moving or demolishing structures. Any building permit or such other permit not issued in conformity with this section shall be invalid. A Certificate of Appropriateness shall be

required whether or not a building or other permit is required. The Town of Wake Forest and other public entities shall be required to obtain a Certificate of Appropriateness prior to any changes in the character of public facilities, utilities, or public buildings.

2. **COA Conditions of Approval**: In approving a Certificate of Appropriateness, the Commission may attach reasonable conditions necessary to carry out the purposes of this ordinance.
3. **Exterior Features**: For purposes of this ordinance, "exterior features" shall include the architectural style, general design, and general arrangement of the exterior of a building or other structure, including the kind and texture of the building material, the size and scale of the building or other structure, and the type and style of all windows, doors, light fixtures, signs, and other appurtenant fixtures, as well as historic signs, significant landscape, archaeological and natural features of the area, and shall apply to all sides of any such structures that can be seen from any adjacent street (excluding rear lanes or alleys) or public park. In the case of outdoor advertising signs, exterior features" shall mean the style, material, size, and location of all such signs.
4. **Limitation on Review of Interior Features**: Notwithstanding this ordinance, jurisdiction of the Commission over interior spaces shall be limited to specific interior features of architectural, artistic, or historical significant in publicly owned landmarks, and of privately owned historic landmarks for which consent for interior review has been given by the owner. If an owner's consent for interior review has been filed in the office of the Wake County Register of Deeds and indexed according to the name of the owner of the property in the grantee and grantor indexes, such consent shall bind future owners and/or successors in title. The ordinance establishing the historic designation shall specify the interior features to be reviewed and the specific nature of the Commission's jurisdiction over those features.
5. **Normal Maintenance and Repair/Certain Changes Not Prohibited**: Nothing in this ordinance shall be construed to prevent the ordinary maintenance or repair of any exterior architectural feature of a historic landmark or property located within a district that does not involve a change in design, material, or outer appearance thereof. Nor shall this ordinance be construed to prevent the construction, reconstruction, alteration, restoration, moving, or demolition of any such feature when a building inspector or similar official certifies to the Commission that such action is required for the public safety because of an unsafe or dangerous condition. Nothing herein shall be construed to prevent a property owner from making any use of their property not prohibited by other statutes, ordinances, or regulations. Nothing in this ordinance shall be construed to prevent the maintenance of or, in the event of an emergency, immediate restoration of any existing above-ground utility structure without approval by the Commission.
6. **Use of Design Standards**: The Commission shall adopt, utilize, and amend, as needed, standards, not inconsistent NC General Statutes and the US Secretary of the Interior’s Standards for Rehabilitation for altering, restoring, moving, or demolition of property designated as historic. It is the intention of these standards to ensure, insofar as possible, that changes in designated landmarks or properties located within designated districts shall be in harmony with the reasons for designation.
7. **Administrative Approval for Minor Works Allowed**: The Commission staff may issue a Certificate of Appropriateness for minor works as listed in the Commission's Design Standards or as otherwise directed by the Commission. Minor works shall include and are defined as those exterior changes that do not involve substantial alterations, additions, or removals that could impair the integrity of the property and/or district as a whole. No application for a minor works Certificate of Appropriateness may be denied without formal action by the Commission.

8. **Delay in Demolition of Designated Properties**: Any application for a Certificate of Appropriateness authorizing the relocation, demolition, or destruction of a building or structure within a HL-O may not be denied. However, the effective date of such a Certificate of Appropriateness may be delayed for a period of up to 365 days from the date of approval of the Certificate of Appropriateness. The Commission may reduce the period of delay where it finds that the owner would suffer extreme hardship or be permanently deprived of all beneficial use of or return from such property by virtue of the delay. During such period the Historic Preservation Commission may negotiate with the property owner and any other parties in an effort to find a means of preserving the building, structure or site.
9. **Properties of Statewide Significance**: The Commission may deny an application for a Certificate of Appropriateness authorizing the demolition or destruction of a building, site, or structure determined by the State Historic Preservation Office to have statewide significance, as defined in the criteria of the National Register of Historic Places, unless the Commission finds that the owner would suffer extreme hardship or be permanently deprived of all beneficial use or return by virtue of the denial.

E. **Demolition by Neglect**: Demolition by neglect of any designated historic landmark or property located within a district shall constitute a violation of this ordinance. For the purposes of this ordinance "demolition by neglect" shall generally mean the failure to properly maintain a structure, whether intentionally or not, such that it falls into such disrepair that it may become uninhabitable. The local governing body may take appropriate actions to prevent demolition by neglect, as outlined in Section 16.2.8, provided such actions include appropriate safeguards to protect the property owner from undue economic hardship.

F. **Permitted Uses**: All uses permitted in the applicable land development district underlying a historic overlay district are permitted in the HL-O.

2.4.3. Special Highway Overlay (SH1-O and SH2-O)

A. **Applicability**: The Special Highway Overlay Districts (SH-O) shall apply to all properties located on either side of a major access corridor (as noted below) beginning at the centerline of the existing right-of-way. The depth of the district is 1,000 feet and shall follow identifiable boundaries whenever possible measured on either side of the right-of-way of the major access corridor. All such locations shall be noted on the official zoning map.

1. Highway US-1 (SH1-O)
2. Dr. Calvin Jones Highway (SH2-O)

B. **Exceptions**: Exceptions to the district depth, location, landscaping and buffering can be applied in the following instances:

1. Where identifiable conditions exist to screen the visibility of motorists, or
2. At an intersection targeted for shopping center development.
3. A PUD district may propose acceptable alternative standards within an SH-O district, as it speaks to minimum bufferyard dimensions and supplemental planting standards so long as they are in keeping with the overall intent of this ordinance.

C. **Landscaping and Buffering**: It is the intent of this section that the frontage along the designated thoroughfares to the extent practical be left in an undisturbed or enhanced state of vegetation, and that sufficient areas of natural buffer remain so that the proposed use will be visually in harmony with the natural wooded character of the area. Removing or denuding of natural forest vegetation along major access corridors is strongly discouraged; however, it is understood that conditions may exist as stated in Section 2.2.3.F - Section 2.2.3G, which may warrant removing of natural forest vegetation. (Exemption: Existing lots of record that are developed for single-family detached or duplex dwelling units)

Yard Type/Lot Condition in the SH-O Districts	Required Street Bufferyard to Preserve Natural Vegetation or its Planted Equivalent	Supplement Plantings if Limited or No Vegetation Exists in SH-O Yard
Frontage of the existing or proposed right-of-way	*50 ft average	5 trees per 50 feet of SH-O yard
Frontage of the existing or proposed right-of-way of any access/frontage road adjacent to any major access corridor	*30 ft average	3 trees per 50 feet of SH-O yard
Street frontages of streets that intersect with a major access corridor for a distance of 200 feet	*30 ft average	3 trees per 50 feet of SH-O yard
Those portions of front, rear or side yards that are not adjacent to a major access corridor or not part of the 50 foot SH-O yard and are not devoted to the uses, buildings and structures of a permitted use	Preservation of all existing vegetation	See Section 8.3
*May use existing vegetation within right-of-way to meet street yard width requirement.		

D. Dimensional Requirements:

1. Building Setback: 100 feet from property line abutting major access corridor
2. Off-Street Parking Setback: 50 feet from property line abutting major access corridor

E. Maximum Number of Driveways:

1. One combined entrance and exit shall be permitted for each lot with frontage along a major access corridor;
2. For lots with 500 feet or more of frontage along a major access corridor 2 combined entrances and exits shall be permitted;
3. For lots with frontage on an access/frontage road adjacent to a major access corridor, the number of entrances shall be determined as provided in Section 9.8 of this ordinance.
4. For projects with an associated Traffic Impact Analysis (TIA), the maximum number of driveways shall be determined though TIA requirements as well as Town and NCDOT approvals.

F. Modification of Standards (Minor): The administrator, in reviewing a development application, may adjust specific SH-O yards and setback requirements for yards adjacent to the major access corridor or intersecting streets provided the average depth of a required yard or setback for the entire parcel is maintained. In permitting site-specific variations the Administrator shall find that the requested modification:

1. Is consistent with the overall purpose and intent of these requirements;
2. Is necessitated by the configuration and/or topography of the land, which makes it impractical to comply with the yard and setback requirements of this section for specific areas of the parcel;
3. Does not reduce the required yard or setback by more than 50%.

G. Modification of Standards (Major): The Board of Commissioners, in reviewing a development application, may adjust (either reduce or increase) minimum SH-O yards and setback requirements for yards adjacent to the major access corridor or intersecting streets upon making a finding that the proposed adjustment of those requirements:

1. Is consistent with the overall purpose and intent of these requirements;

2. Is necessitated by the configuration and/or topography of the land, which makes it impractical to comply with the yard and setback requirements of this section;
3. Is no greater than is necessary to allow for reasonable development of the tract;
4. Will not adversely affect the value of adjoining or abutting property, or that the use is a public necessity; and
5. Is necessitated to preserve existing natural vegetation considered to be a landmark or in an advanced stage of growth, removal of which would visually affect the natural wooded character of the area.

H. **Expansions and Changes of Use**: For properties which have expansions or additions which singularly or collectively exceed 25% of the gross floor area and/floor surface area, or change use which requires additional off-street parking made after application of this section, the SH-O yard requirements are as follows:

1. Where adjacent to a major access corridor, provide SH-O yard of 25 feet of natural vegetation or planted equivalent. Screening shall be provided at a rate of 3 trees per 50 linear feet of SH-O yard.
2. Where adjacent to a street intersecting a major access corridor, provide a SH-O yard of 15 feet of natural vegetation or planted equivalent. Screening shall be provided at a rate of 2 trees per 50 linear feet of SH-O yard.

2.4.4. Required Shopfront (SF)

A. **Intent**: While retail/restaurant uses are not required uses, the intent of the Required Shopfront Overlay is to provide a building frontage that would not preclude those uses at some point in the future through the depth of the first and second layer.

B. **Permitted Frontages**: If a block face is designated on the Zoning Map as "Required Shopfront," then all new development along that designated street frontage must provide one of the following Private Frontages (per Section 5.3) at sidewalk level along the entire length of the frontage:

1. Shopfront & Awning,
2. Gallery, or
3. Arcade.

2.4.5. Water Supply Watershed Protection Overlay Districts

Development standards for state designated water supply watershed protection areas apply within the following districts as outlined in Section 12.6.

A. FL-CA (Falls Lake Critical Area) District;

B. FL-WMA (Falls Lake Watershed Management Area) District;

C. RC-CA (Richland Creek Critical Area) District;

D. RC-WMA (Richland Creek Watershed Management Area) District;

E. SC-CA (Smith Creek Critical Area) District;

F. SC-WMA (Smith Creek Watershed Management Area) District; and

G. LR-WMA (Little River Watershed Management Area) District

2.4.6. Glen Royal Mill Village Character Preservation Overlay (MVCP-O) District

A. **Purpose**: The Glen Royall Mill Village Character Preservation Overlay District is a zoning overlay district dedicated to the protection of traditional development patterns and neighborhood character specifically in this National Register Historic District. Regulations promote the continuity of the streetscape, the reduction of conflict between new construction and existing development, and the integrity of the rich history of the Town of Wake Forest. The Glen Royall Mill Village Character Preservation Overlay District is comprised of the properties shown within

the MVCP-O area on the zoning overlay map. These properties are in the Glen Royall Mill Village National Register Historic District. It is an area made up primarily of single-family detached homes. Originally constructed as housing for the mill workers, many of the structures remain well-kept with minor exterior alterations. This overlay district seeks to protect the special character and charm of this significant historic district.

B. **Applicability**: All properties within the Glen Royall Mill Village Character Preservation Overlay District. Those properties that are also located within the Wake Forest Local Historic District are exempt from the regulations contained herein but are subject to the regulations contained in Section 2.4.2, the Historic District and Landmarks Overlay (HL-O) District.

C. **Developments Standards**:

1. **Dimensional and Development Standards**

   a. **Minimum Lot Area**: 6,500 sf

   b. **Maximum Lot Area**:

      i. Residential: 20,000 sf

      ii. Non-residential: 2 acres

   c. **Principal Front Setback**: The principal building setback shall be no more or no less than five feet (5') from the average established front yard of developed lots within 300' on each side of such lot, fronting on the same street as such lot, and within the MVCP-O.

   d. **Building Coverage**: Maximum building coverage shall not exceed twenty-five percent (25%), inclusive of any accessory buildings and/or permanent structures.

   e. **Building Height**: The building height shall not exceed the greater of one story or the average height of the principal structures of the same use on lots within 300' on each side of such lot, fronting on the same street as such lot, and within the MVCP-O.

   f. **Parking**:

      i. Off-street parking shall be provided in accordance with the requirements of Section 9.3 and 9.4 for the specific use and underlying zoning district. It should be noted that if parking is provided within the first layer, it must be located outside the public right-of-way.

      ii. **Driveways**. Where a gravel surfaced driveway is provided, a concrete driveway apron shall be required.

   g. **Garages and Accessory Structures**:

      i. No portion of any detached garage, carport, or accessory structure shall be located in the front yard nor shall it protrude beyond the primary facade of the principal structure.

      ii. Attached garages are prohibited.

      iii. Accessory structures shall not exceed 80% of the height of the primary structure.

   h. **Fences and Walls**:

      i. Walls are prohibited, except for retaining walls necessary for soil erosion, retaining purposes.

      ii. Height: In front and side yards, fences shall not exceed 42" in height from the front property line to the rear corner of the principal building. In rear yards,

fences shall not exceed six feet and shall not be installed in front of the rear corner of the principal building.

iii. Allowable materials: treated wood, decorative iron, and decorative metal.

iv. Prohibited materials: vinyl.

v. Design: Shall be vertically oriented. Split rail and chain link are prohibited. Privacy fences and garden fences, such as chicken wire, are permitted only in the rear yard.

2. **Design Standards**

The following design standards shall be applied to alterations to existing structures and new construction. The following design standards do not apply to ordinary maintenance or repair of the exterior of existing structures.

a. **Residential and Lodging Uses**

i. Porches: Front porches and existing entrances shall be preserved and/or replication of entrances and porches shall be based on historical evidence. As such, existing front porches shall not be enclosed or screened in; however, existing screened in front porches are permitted and may be repaired or replaced provided that transparent screens are utilized and installed from the inside of the porch, behind the railing and other porch features. If new construction is proposed, front porches shall be provided and meet the following standards:

(a) Span a minimum of 50% of the front façade width

(b) Be located symmetrically on the front façade

(c) Shall not be enclosed or screened in

ii. Roof: Only Side-Gable, Pyramidal, Triple-A Gable, and Gable-front roof types are permitted.

iii. Building materials: Exterior walls shall be finished in wood clapboard, cementitious fiber board, wood shingle, wood drop siding or primed board. Brick, stone, stucco and vinyl siding are not permitted. Except that:

(a) Existing structures may replace existing materials in kind, and

(b) Accessory buildings not visible from the public right-of-way are not subject to the building material requirements.

iv. Foundation materials: Principal building foundations shall be brick or brick veneer.

v. Finished Floor Elevation: The finished floor elevation at the front façade shall be a minimum of 18 inches above grade for principal structures.

vi. Utilities: Skylights, solar panels, utilities, mechanical equipment, satellite dishes, air conditioning units, and associated structures shall only be located on rear or side slopes of the roof, on rear or side portions of the building, and in rear or side yards provided they are not visible from the public right-of-way or are screened from view from the public right-of-way with vegetation or fencing.

b. **Civic and Educational Uses**.

i. Building materials: Exterior walls shall be finished in accordance with Section 5.4.2.D, {} except that stucco shall not be permitted.

ii. Orientation: The primary entrance shall face the primary street. If side or rear parking is utilized, a front entrance shall still be provided.

iii. ADA Compatibility: Fire exits, landings, ramps, chair lifts, and other access features shall be located on the building where they have the least visibility and impact to the character of the structure, when possible. When appropriate temporary structures may be approved by the Administrator.

iv. Utilities: Skylights, solar panels, utilities, mechanical equipment, satellite dishes, air conditioning units, and associated structures shall only be located on rear or side slopes of the roof, on rear or side portions of the building, and in rear or side yards provided they are not visible from the public right-of-way or are screened from view from the public right-of-way with vegetation or fencing.

c. **Non-Residential Uses in Residential Structures**. Historically significant residential structures in the Glen Royall Mill Village may be repurposed for uses other than residential. In order to preserve the architectural integrity and special historical character of these structures in Glen Royall Mill Village, the following apply to nonresidential uses within detached dwellings in addition to the requirements of Section 2.4.6.C.1.b.(1): {}

i. The residential character and architectural elements of the house shall remain unchanged.

ii. With the exception of door and window replacements, which shall match the size of the existing openings, and routine repair and maintenance, there may be no other alterations to the front façade of the building.

iii. Building additions must be in accordance with Section 2.4.6.D. {}

iv. On-site parking shall be located to the side or rear of the principal structure.

d. **Additions**. The following standards are applicable to all additions in the Glen Royal Mill Village Character Preservation Overlay (MVCP-O) District

i. Additions shall be located to the rear of the structure or the most inconspicuous side of the building. Additions to roofs shall not be visible from the front elevation. The addition shall be sited such that it is clearly an appendage and distinguishable from the existing main building. Additions shall be recessed behind the rear corner of the principal structure and shall not exceed the height of the principal structure or be visible from the front of the structure.

ii. Additions shall be constructed with the least possible loss of historic building material and without damaging or obscuring character-defining features of the building, including, but not limited to, rooflines, cornices, eaves, and brackets. Additions shall be designed to be reversible with the least amount of damage to the historic building so that if removed in the future, the historic building will be intact.

iii. Additions, including multiple additions to structures, shall:

iv. (a) Not increase the floor area of the main structure by more than 100%.

v. (b) Not increase the height of the main structure nor shall the addition exceed the height of the main structure.

vi. Designs for additions shall be compatible with the building design standards of Chapter 5 of this Ordinance.

D. **Submittal Requirements.** In addition to the standard submittal requirements, applications in the Glen Royall Mill Village Character Preservation Overlay District shall also include building elevations, site plan, and floorplans.

2.5. Floating Overlay Districts

The floating overlay districts are included as tools for development regulation that will encourage integrated mixed-use development as the town continues to grow and expand. The intent of the floating overlay districts is to allow more flexibility for these types of development in certain instances without requiring a standard legislative rezoning process. Instead, administrative (by-right) and/or quasi-judicial processes are established to allow development to proceed under the regulations outlined for each floating overlay district. When a floating overlay district is applied, the requirements for the floating overlay district shall supersede any conflicting requirements of the base district. All requirements of the base district that do no conflict with the standards of the floating overlay district shall apply.

2.5.1. Traditional Neighborhood Development (TND)

A. **Purpose and Intent:** The Traditional Neighborhood Development (TND) is a floating overlay district option established to allow for the development of fully integrated, mixed-use, pedestrian-oriented neighborhoods in order to minimize traffic congestion, suburban sprawl, infrastructure costs and environmental degradation. This district is a planned development district in that it is created through the combination of other form-based districts as sub-districts under the umbrella of the TND.

B. **Process and Applicability:**

1. The TND Floating Overlay District designation shall automatically apply by-right to all development sites of 100 acres or greater. The approval of TND Master Plans on such properties shall follow the procedures for Subdivision Master Plans found in Section 15.9.2. {} The designation of land allocations by transect zone (as outlined in 2.2.7.D {} below) shall be made a part of this application and approval.
2. Development sites of less than 100 acres may be developed under a TND Floating Overlay District subject to the Conditional District rezoning process established in Section 15.15.A {} TND Master Plan, indicating land allocations by transect zone (as outlined in 2.2.7.D {} below), proposed subdivisions of property, and other information required by Section 15.15 shall be made a part of the Conditional District Master Plan application and approval.

C. **Findings of Fact for TND Master Plan Approval:** In granting approval of a TND Master Plan, the approving authority shall make the following findings of fact, in addition to other findings of fact required elsewhere in this ordinance:

1. The plan is in compliance with the specifications of this ordinance.
2. The plan conforms to the adopted plans (as applicable) for the physical development of the town.
3. The impacts to adjacent property of higher-intensity, non-residential uses are adequately mitigated.
4. The impacts of traffic generated by the TND on the existing road network are mitigated.
5. All neighborhoods have identifiable centers and edges.
6. All lots are within walking distance to retail and/or recreation opportunities (a distance not greater than ¼ mile).
7. Uses and housing types are mixed and in close proximity to one another.
8. Street networks are interconnected and blocks are small.
9. Civic buildings are given prominent sites throughout the neighborhood.

D. Maximum Permitted Densities:

Underlying District	Maximum Overall Density
RD District	6 du/ac
GR3	6 du/ac
GR5	10 du/ac
GR10	16 du/ac
All Other Districts	Not Restricted

E. Land Allocation by Transect Zone: When composing the TND Master Plan, the form-based districts in Section 2.2.1 {} shall be used as sub-districts and so designated on the zoning map within the ranges noted below (ranges are noted in % of gross land area).

1. **UR:** 30-80%
2. **RMX:** 10-30%
3. **NMX:** 10-30%
4. **Civic Structures:** A minimum of 2% of the land area shall be reserved for the construction of civic structures (community buildings, religious institutions, etc.) and their support facilities (parking areas, etc.). Such sites shall be in prominent locations that are centralized to the neighborhood, accessible to the greater community, and help to visually anchor important vistas. The required reservation does not include recreational open space such as parks, playgrounds, greenways, or conserved lands.

F. Specific Development Standards

1. **Neighborhood Design:** The entire land area of the TND shall be divided into blocks, streets, lots and open space areas.
2. **Land Use Relationships:** Similar land use categories shall generally front across streets. Dissimilar categories shall abut at rear lot lines. Corner lots which front on streets of dissimilar use shall be set back the same as the adjacent use with the lesser setback.
3. **Open Space:** No portion of the TND shall be further than ¼ mile from a publicly accessible (public or privately maintained with a public access easement) recreational open space as defined in Chapter 7 including recreational open space outside of the TND boundaries. Recreational Open Space shall be provided in accordance with the requirements of Chapter 7.
4. **Dimensional Standards and Building Types:** The Dimensional Standards and Building Types shall be established in accordance with the neighborhood design, but within 200 feet of all property boundaries (not across streets) the lot widths and depths and building types shall be generally consistent with adjacent zoning district(s) of a lower development intensity/density.

2.6. Conditional Districts (CD)

Conditional Districts are districts with conditions voluntarily added by the applicant and approved in a legislative procedure by the Board of Commissioners in accordance with NC General Statutes via the conditional zoning process outlined in Chapter 15. Conditional Districts provide for orderly and flexible development under the general policies of this ordinance without the constraints of some of the prescribed standards guiding by-right development. Because Conditional District developments are constructed in a comprehensive manner, they establish their own building, street, block, and lot pattern which may be unique from other surrounding blocks or neighborhoods. Conditional zoning may be used in any district but is not intended to relieve hardships that would otherwise be handled using a variance procedure.

2.6.1. Standards For Conditional Districts

Within a Conditional District (CD), petitioners may place additional requirements or standards onto themselves and their property or ask that certain uses identified in the specific zoning category or provisions in Chapters 2-12 be decreased. It shall be the Board of Commissioners' final decision to grant approval or denial of the conditional zoning request in light of the revised development standards presented in accordance with the procedures of Section 15.15. If no specific request is made by the petitioner to the change in the development standards or if the petition is silent on the point, it shall be understood that the underlying zoning district guidelines and standards shall apply.

In addition to the modification of specific district provisions (except use), the various provisions detailed in Chapters 2-12 may be varied if specifically requested by the petitioner as part a conditional zoning application with the exceptions outlined below:

CH	Title	Exception to modifications:
2	District Provisions	Uses permitted may not be added unless the use proposed is not currently defined or contemplated by the Code. Permitted uses may be removed from the petition.
3	Supplemental Use Standards	
4	General Provisions For All Districts	
5	Building Design Standards	
6	Subdivision & Infrastructure Standards	
7	Recreation Facility Fees, Parks & Open Space Land	May substitute dedication of public open space for recreation facilities fees per Board of Commissioners approval. Amount required may not be reduced.
8	Tree Protection, Buffers & Landscaping	No further modifications permitted.
9	Parking & Driveways	
10	Lighting	
11	Signs	No further modifications permitted.
12	Erosion, Flood, Stormwater & Watershed Standards	No further modifications permitted.

2.7. Planned Unit Development (PUD)

The Planned Unit Development (PUD) district is designed to: promote a compatible mix of uses to instigate an integrated and sustainable development consistent with the Town's unique character. This district shall also encourage design flexibility; multi-modal connectivity between uses; sensitivity to natural resources and environmental features; and facilitate the efficient provisions of infrastructure, utilities and adequate public facilities.

The PUD district is not intended for use with subdivisions or developments which can be developed under the strict application of the minimum standards of the UDO, thereby resulting in a unique, high quality overall development. The specific procedures for review and approval of a PUD is found in section 15.16, Planned Unit Development. Above all, every PUD established, shall demonstrate consistency with the goals and policies established in the Wake Forest Community Plan.

A. General Applicability: Before any development shall be designated as a Planned Unit Development district on the Official Zoning Map, it shall receive approval pursuant to the terms of this Section and Sec. 15.16 Planned Unit Development.

B. Permitted Uses, Development Standards and Minimum Requirements: In return for greater flexibility in site design, PUD Districts are expected to deliver exceptional quality community designs that preserve critical environmental resources; provide high quality community amenities; incorporate creative design in the layout of buildings and circulation; ensure compatibility with surrounding land uses and neighborhood character; provide high quality architecture; and provide greater efficiency in the layout and provision of roads, utilities, and other infrastructure.

1. **Permitted Uses.** Permitted uses in any PUD district may include any uses permitted as specified in Section 2.3.3 Use Table {} , excluding non-permitted uses. The uses proposed in the PUD concept plan may include any residential, commercial/mixed uses or industrial uses or combination of uses deemed appropriate for the real estate.

2. **Development Standards.** All PUD Concept Plans shall specify development standards applicable to each permitted uses in the PUD (see Section 15.4.3 for exact requirements). Development standards applicable to the PUD shall be those specified in the PUD Concept Plan filed with the zoning map change. The concept plan shall establish the following development standards:

   a. The location of uses proposed by the PUD must be shown in the PUD Concept Plan with a maximum density for each type of residential use; a maximum number of units for multi-family dwellings; and a maximum square footage for each type of non-residential use.

   b. The dimensional standards in Sec. 4.3, *Basic Lot and Use Standards {}* may be varied in the PUD Concept Plan. The PUD shall demonstrate compliance with all other dimensional standards of this ordinance, North Carolina Building Code, and North Carolina Fire Code.

   c. Pedestrian ways, bikeways and other transportation systems that encourage cluster and compact development.

   d. Land use patterns that promote and expand opportunities for walkability, connectivity, public transportation, and an efficient compact network of streets. Cul-de-sacs shall be avoided to the greatest extent possible.

   e. Identified active open space areas and those significant natural and environmental features that will be protected and preserved in their natural state.

   f. Architectural and design criteria that provide higher quality than routine developments. All residential uses proposed shall provide typical architectural elevations representative of the residential structures to be built to ensure the Standards of this Section are met.

   g. Phasing. The PUD Concept Plan shall include a phasing plan for the development and associated infrastructure improvements as outlined in Section 6.5. If development of the PUD is proposed to occur in more than one phase, then guarantees shall be provided for project improvements, including improvements required by the TIA and NCDOT. In phases that include residential, amenities that are necessary and desirable of the project, or that are of benefit to the Town, are constructed within that phase of the project.

3. **Minimum Requirements.**

a. **Open Space**. Each PUD district shall clearly identify areas of required open space within the PUD concept plan. Open space areas shall conform to Section 7: {} *Recreation Facility Fees, Parks & Open Space Land* of the UDO.

b. **Landscaping, Buffering and Tree Preservation**. All landscaping, buffering and tree preservation shall be required in accordance with {} Section 7: *Recreation Facility Fees, Parks & Open Space Land* {} and Section 8: *Tree Protection, Buffers and Landscaping* of the UDO except that variations from these standards may be permitted so long as areas normally required may be made up on other portions of the PUD. Such buffers and tree protection areas shall be indicated on the final plat, which shall include information regarding ownership, maintenance and use limitations.

c. **Off-street Parking and Loading**. The PUD Concept Plan shall demonstrate compliance with the standards of Sec. 9 *Parking & Driveways*, {} except that variations from these standards may be permitted if a comprehensive parking and loading plan for the PUD is submitted as part of the PUD Concept Plan that is determined to be suitable for the PUD, and generally consistent with the intent and purpose of the off-street parking and loading standards.

d. **Signs**. Signage shall demonstrate compliance with Sec. 11 *Signs*, {} except that the standards can be varied if a master signage plan is submitted for review and approval concurrent with the PUD concept plan and is determined by Town staff to be suitable for the PUD and generally consistent with the intent and purpose of the sign standards of the UDO.

e. **Public Facilities**. The improvements standards and guarantees applicable to the public facilities that will serve the site shall comply with {} Section 6: *Subdivision and {}* Section 7: *Recreation Facility Fees, Parks & Open Space Land* as well as the following standards:

i. The PUD Concept Plan demonstrates a safe and adequate on-site transportation circulation system. The on-site transportation circulation system shall be integrated with the off-site transportation circulation system of the Town. The PUD Plan shall be consistent with the Wake Forest Transportation Plan and the *Wake Forest Manual of Specifications, Standards and Design* and show required right-of-way widths and road sections. A Traffic Impact Analysis (TIA) shall be required.

ii. The PUD Concept Plan demonstrates a safe and adequate on-site system of potable water and wastewater lines that can accommodate the proposed development and are efficiently integrated into off-site potable water and wastewater public improvement plans. The PUD Concept Plan shall include a proposed water and wastewater plan.

iii. Adequate off-site facilities for potable water supply, sewage disposal, solid waste disposal, electrical supply, fire protection and roads shall be planned and programmed for the development proposed in the PUD Concept Plan.

iv. The development is conveniently located in relation to schools and public safety protection services.

f. Natural Resources and environmental protection. The PUD Concept Plan for PUD demonstrates compliance with the current regulatory standards of this Ordinance related to natural resource and environmental protection in Sec. 12.3 *Erosion and*

Sedimentation Control Regulations, 12.4 *Flood Damage Prevention*, 12.5 *Stormwater Management*, 12.6 *Water Supply Watershed Protection Regulations*, & 12.7 *Watercourse (Riparian Buffer Areas)*.

g. Storm water management. The PUD Concept Plan shall demonstrate that the post-development rate of on-site storm water discharge from the entire site shall not exceed pre-development levels in accordance with Sec. 12.5.3 of the UDO.

h. Complies with other relevant portions of UDO. The PUD Concept Plan demonstrates compliance with all other relevant portions of the UDO.

7. Recreation Facility Fees, Parks & Open Space Land

7.1. PURPOSE AND INTENT

It is the intent of this chapter is to require that each new development contribute to the necessary range of parks and opens space critical to the quality of life for each resident and visitor. It is expected that all new residential development provide centrally-located, unencumbered land as neighborhood park space for human use and/or unimproved open space in addition to contributing to the construction and expansion of community facilities. The required neighborhood park or open space is intended to compliment the community facilities that are supported by the required Recreation Facility Fees.

7.2. APPLICABILITY

Any person developing and/or subdividing property for residential purposes subject to this ordinance shall be subject to the open space standards and Recreation Facility Fee levied by the town.

7.3. RECREATION FACILITY FEE

Pursuant to the authority granted to the town by the State of North Carolina in Chapter 502, Senate Bill 576 (1989), the town shall impose a Recreation Facility Fee for each new single-family or multifamily dwelling unit including, but not limited to, condominiums, town homes, apartments, and duplexes built in the town or the town's extraterritorial planning area.

7.3.1. Applicability

A. All residential subdivisions, multi-family developments, planned unit developments and manufactured home parks for which town approval or permitting is required, or real property improvement which results in the creation of residential dwelling units shall be subject to payment of the Recreation Facility Fee.

B. No building permit shall be issued for any new residential dwelling unit until the Recreation Facility Fee has been paid to the town in full.

7.3.2. Exceptions

A. The Recreation Facility Fee shall not apply to fences, billboards, poles, pipelines, transmission lines, advertising signs or similar structures and improvements, renovations and repairs which do not generate the need for additional or expanded recreational facilities.

B. The Recreation Facility Fee shall not apply to residential subdivisions, multi-family developments, planned unit developments and manufactured home parks, which have received master plan approval and are still valid and active or an established zoning vested right prior to November 17, 1998.

7.3.3. Credits

The required Recreation Facility Fee may be credited, subject to approval by the Board of Commissioners, by an equivalent amount of land dedication and/or construction of greenway trails noted on an adopted plan.

7.3.4. Fee Amounts

The Recreation Facility Fee shall be paid to the town in the amounts as determined by the Board of Commissioners.

7.3.5. Appeals

Any person who feels aggrieved by any action of the town in imposing the facilities fee on a development or the town's classification for the purpose of establishing the rate, must first pay the amount of the facilities fee so charged to him/her, with such amount clearly marked as paid under protest, and thereafter give notice of appeal within a period of 30 days after such payment. Such notice should be delivered by personal service (as defined in Section 1A-1, Rule 4 of the N. C. General Statutes) or registered or certified mail, return receipt requested, directed to the Town Manager. A public hearing shall be held by the Board of Commissioners to review said matter within a period of 35 days following receipt of notice of appeal; the decision upon said appeal shall then be subject to review by the Superior Court by proceedings in the nature of certiorari; any petition for review by the Superior Court shall be filed with the clerk of Superior Court of Wake County within a period of 30 days following the date the decision of the Board of Commissioners is delivered in writing to the appealing party, said delivery to be either by personal service or by registered mail or certified mail, return receipt requested.

7.4. NEIGHBORHOOD PARKS AND OPEN SPACE DEDICATION REQUIREMENTS

In addition to the required Recreation Facility Fees note in 7.3, all new development shall provide neighborhood parks and undisturbed open space (as applicable). The intent is to ensure that each new home has a range of parks and open spaces within a typical walking or biking distance of ¼ to ½ mile.

7.4.1. Required Open Space Conservation/Recreation Space Table

The amount of open space and recreation space required (measured as a percentage of the gross area of development) shall be as follows:

Context	Category	Required Park Space (Improved) – See Standards in Section 7.5	Required Open Space (Unimproved) – See Standards in Section 7.6 {}	Total Dedicated Space
Rural	OS	Exempt	Exempt	Exempt
	RD	2.5%	10%	12.5%
Suburban	GR3, GR5, GR10	2.5%	10%	12.5%
	NB/HB	Exempt	Exempt	Exempt
	ICD	Exempt	25%	25%
	LI/HI	Exempt	Exempt	Exempt
Urban	UR, RMX	2%	5%	7%
	RA-HC/ NMX/UMX	2% for projects 5 acres or greater	Exempt	2% for projects 5 acres or greater
	PUD	2%	15%	17%

7.4.2. Open Space Types

Developments required to provide open space may use the following types to meet the requirements of this Section.

A. Unimproved Open Space;

1. Standards

Pursuant to Section 7.4.7 {} , development in certain districts may only require simple open space. Public accessibility is not required or expected but is permitted. Where practical, the following priority list shall be used for the conservation of such areas:

a. Primary Conservation Areas (riparian corridors, special flood hazard areas, unique geological formations, rock outcroppings, rare plants, rare plant communities, rare habitats, wetlands, & prime agricultural areas/farmland),

b. Unbuildable Areas (areas that have highly erodible soils or slopes in excess of 60%), and

c. Streetyard and perimeter buffers;

d. Tree save areas;

e. Environmentally sensitive areas including but not limited to: drainage areas, floodways, riparian buffers, wetlands; and

f. Public utility easements

7.4.3. Reserved

7.4.4. Exemptions

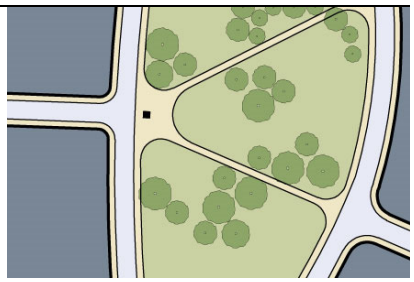
A. **Very Low Density Developments:** Neighborhood parks are not required in any residential development with an overall density of 1 unit/acre or less.

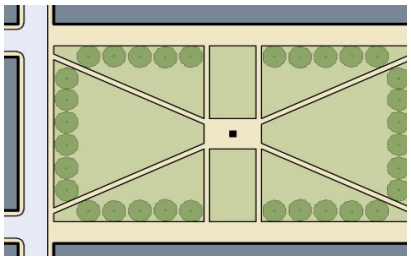
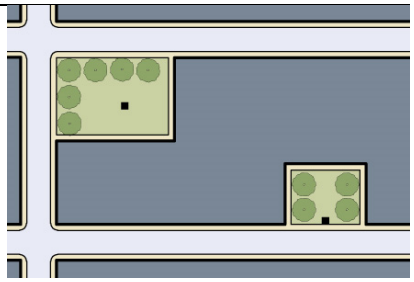
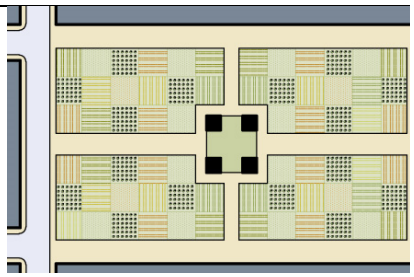
B. **Conditional Districts:** Exemptions may be permitted on a case-by-case basis through the use of a Conditional District rezoning, but shall have a minimum of 50% of the total required open space.

7.5. NEIGHBORHOOD PARK DESIGN STANDARDS

7.5.1. Required Neighborhood Park Types

Neighborhood parks, as required by the district provisions, shall conform to one or more of the typologies defined below.

A. Park/Greenway: A natural preserve available for unstructured recreation. Its landscape shall consist of paths and trails, meadows, waterbodies, woodland and open shelters, all naturalistically disposed. Parks may be linear, following the trajectories of natural corridors (greenways). The size shall generally be 1-5 acres (except Greenways where there is no minimum).	
B. Green: An open space available for unstructured recreation. A Green may be spatially defined by landscaping rather than building frontages. Its landscape shall consist of lawn and trees, naturalistically disposed. For the purposes of this section, standalone dog parks shall be considered a variation of the Green park type. The minimum size shall be 1/2 acre.	

C. Square: An open space available for unstructured recreation and civic purposes. A Square is spatially defined by building frontages. Its landscape shall consist of paths, lawns and trees, formally disposed. Squares shall be located at intersections. The minimum size shall be 1/4 acre and the maximum shall be 2 acres.	
D. Playground: An open space designed and equipped for the recreation of children. A playground may include an open shelter. Playgrounds shall be interspersed within Residential areas and may be placed within a block. Playgrounds may be included within parks and greens. There shall be no minimum or maximum size.	
E. Community Garden: A grouping of garden plots available for small-scale cultivation, generally to residents of apartments and other dwelling types without private gardens. Community gardens should accommodate individual storage sheds.	

7.5.2. Location

A. Land for neighborhood park spaces shall be centrally and internally located so as to serve the needs of the residents of the neighborhood.

B. Required neighborhood parks shall provide focal points for developments.

C. Areas described in the Wake Forest Community Plan, Open Space & Greenway Plan or any other adopted plan as park, recreation, and open space land or greenways shall be preserved and dedicated where practical and feasible. All such dedication and improvement shall also be in conformance with all applicable federal and state rules and/or interlocal agreements. For developments that abut or include areas designated as future greenways on an adopted plan, the Administrator shall require a dedicated 20-foot minimum width public pedestrian and non-motorized vehicle easement be dedicated along all such areas.

7.5.3. Accessibility / Visibility

A. All recreation spaces shall be conveniently accessible to all residents of the development, and shall have at least 20 feet of frontage on at least one public street within the development.

B. No residential unit within a development shall be further than ¼ mile (1320 feet), as measured along a road or pedestrian path, from a recreation space as defined above or other publicly-accessible park facility.

C. All recreation spaces shall be visible from dwelling units that are adjacent to the neighborhood park. This includes dwelling units on properties that share a property boundary with the neighborhood park or front the neighborhood park from directly across a street.

7.5.4. Usability

A. At least one-quarter of the total land dedicated shall be located outside special flood hazard areas, watercourses, and watershed buffers. All land dedicated shall be outside of wetlands and waters subject to State or Federal regulatory jurisdiction. Within the area proposed for dedication, sufficient engineering data and/or detail shall be indicated to ensure compliance with this section.

B. Areas including ponds, lakes, wetlands, or easements for public utility transmission lines shall not exceed more than 50% of the required neighborhood park space.

7.5.5. Minimum Amenities Within Parks

Required recreation space shall be planned, improved, and usable by persons living nearby. Improved shall mean cleared of underbrush and debris and shall contain 2 or more of the following amenities: landscaping, walls or pathways, fences, walks, lighting and electricity, fountains, ball fields, and/or playground equipment.

A. Minimum Amenities (All Neighborhood Park Types):

1. Public Seating: Provide seating areas appropriate to the intended use of the space (e.g., park benches and durable theft/vandalism-resistant chairs in formal/active spaces and garden wall seats in informal/passive spaces).
2. Supplement Tree Planting/Significant Species Preservation: A minimum of 1 tree (2 inch caliper minimum measured 6" above the ground at installation) to be planted in at least 350 square feet of soil or 1 preserved existing canopy tree a minimum of 12" caliper for every 2,500 square feet of required park space.
3. Trash Receptacle: Garbage receptacles and recycling receptacles shall be required for each park space.
4. Bicycle Parking: At least 4 ~~Class III~~short-term bicycle parking spaces shall be required for every one-quarter acre of neighborhood park space and every ½ mile of greenway. Bicycle parking shall be designed according to the bicycle parking standards in Section 9.6.

B. Minimum Amenities (Parks per 7.5.1.A): At least 25% of the park space land shall be required to be designated for active recreation purposes such as playgrounds, tennis courts, ball fields, volleyball courts, etc. The remainder of the park may be designed for passive recreation purposes such as walking, jogging, cycling, disc golf, relaxation, etc. Preservation of natural or cultural resources such as steep slopes, rock outcroppings, mature woodlands or water resources may also be counted towards passive recreation provided there is some method for public enjoyment and appreciation of such resources.

C. Minimum Amenities (Playground per 7.5.1.D): Playground equipment shall be equivalent to the standards established by the Consumer Products Safety Commission and ASTM for playgrounds.

D. Minimum Amenities (Greenway per 7.5.1.A): A greenway path is credited toward the minimum park space dedication requirement at a rate equal to the length of the path times 20 feet in width. The minimum width of the paved path shall be 10 feet.

7.5.6. Credit For Constructed Neighborhood Amenities

Developments that provide neighborhood amenity facilities will receive a credit of 50% of the required total, subject to the provisions below.

A. The facilities are open to all residents of the neighborhood and are not subject to a private membership separate from any related HOA dues.

B. Such facilities shall, at a minimum, include a clubhouse a minimum of 1,000 square feet and either tennis court(s) or a pool/ waterpark/sprayground.

7.6. OWNERSHIP & MAINTENANCE

Neighborhood Parks or open space land shall be held and maintained by a homeowner's association. A metes and bounds description of the space to be preserved and limits on its use shall be recorded on the development plan, in homeowner covenants, and on individual deeds when open space lands are not held entirely in common. Alternative means of permanent open space preservation may include acceptance by a land conservation trust or a unit of government. Private management alternatives will also be permitted. Such open space shall perpetually run with the project and shall not be developed or separated from the project at a later date (unless no development of any portion of the project which is benefited by or required to provide such open space has occurred and the entire area of the project is presented for a new construction drawing approval, final plat approval, or rezoning, the effect of which will be to nullify the prior approval).

9. Parking & Driveways

9.1. PURPOSE AND INTENT

Parking lots and similar facilities are necessary elements in the urban environment. However, the provision of parking facilities must be regulated in order to avoid negative impacts such as:

- Increased storm water volume and velocity,
- Increased surface pollutants,
- Increased surface level heat and glare,
- Reduction in the efficiency of the connecting street system, and
- Reduction in the operations of the surrounding pedestrian and bicycle network.

The purpose of this chapter is to ensure the adequate provision of parking in Wake Forest without degrading the urban or natural environment.

9.2. APPLICABILITY

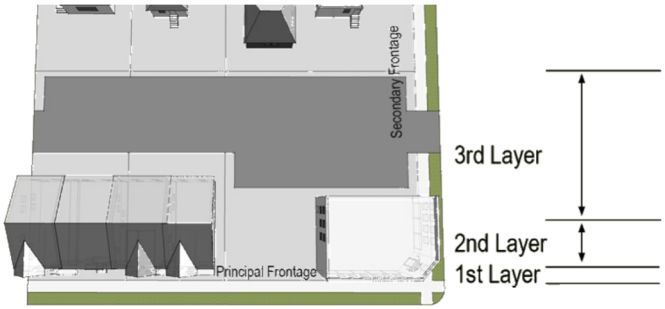
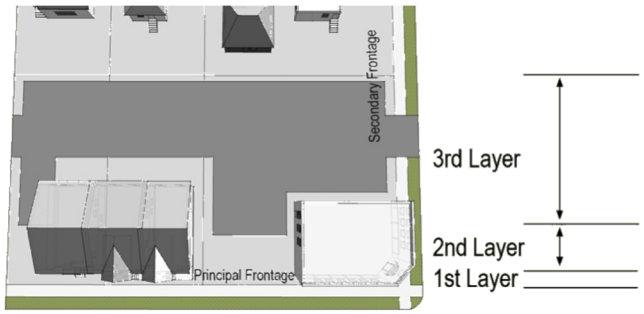
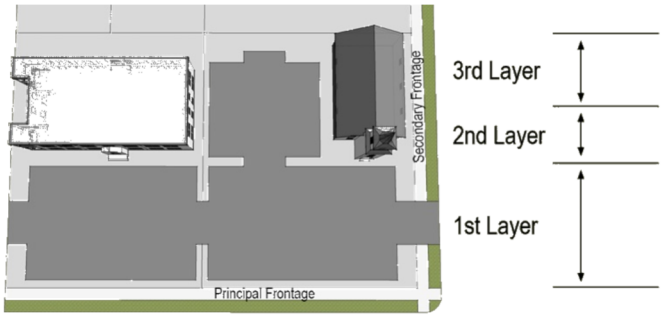
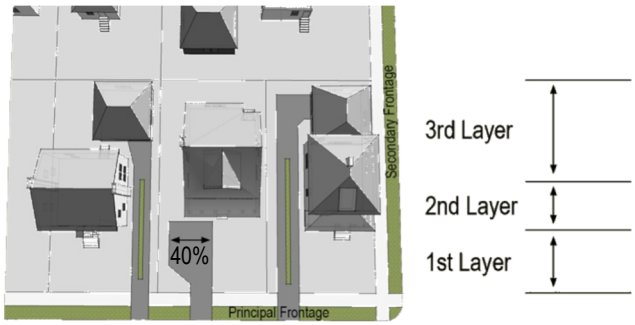
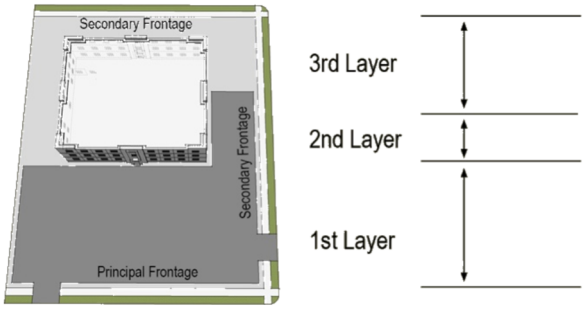
The provisions of this chapter shall apply to all new and expanded development, as well as any changes in use. The notable exception shall be any Planned Unit Development District, which is intended to create its own parking standards through the PUD Concept Plan.

9.3. PERMITTED PARKING LOCATIONS

	Civic/Institutional	Detached House	Townhouse	Apartment	Commercial	Mixed-Use	All Other Bldgs
OS	n/a	n/a	n/a	n/a	n/a	n/a	n/a
RD	U	U	–	–	–	–	–
GR3 & GR5	U	U	–	–	–	–	–
GR10	C	D	B	B	–	–	–
NB	C	D	–	–	C	C	–
HB	C	–	–	–	U	C	–
ICD	B	D	B	B	B	B	
LI	–	–	–	–	U	U	U
HI	–	–	–	–	U	U	U
UR	B	D	B	B	–	–	–
RMX	B	D	B	B	B	B	–
NMX & RA-HC	B	D	B	B	B	B	–
UMX	B	–	A	A	A	A	–

Permitted Parking Configurations*
(Also see diagrams below)
Location A – *Parking permitted in 3rd Layer only*
Location B – *Parking permitted in 2nd and 3rd Layers only*
Location C – *Parking permitted in 2nd and 3rd Layers. Parking in 1st Layer restricted to one drive aisle with 2 bays.*
Location D – *Parking permitted in 2nd and 3rd Layers. Parking in 1st Layer restricted to a driveway or paved surface not to exceed 40% of the lot width.*
U – *Unrestricted*

* These requirements are intended to be applied from the principal frontage of the lot as determined by the Administrator. Parking configurations may have additional restrictions specified in the tables of district standards in Sections 2.2.3 and 2.2.5, and in Chapter 5 – Building Design Standards, and, if located in the Special Highway Overlay (SH1-O and SH2-O) District, in Section 2.4.3 or in the Glen Royall Mill Village Character Preservation Overlay District in Section 2.4.6. {} The Administrator may waive or alter parking configuration requirements to accommodate unique constraints, such as severe topography, on a site-by-site basis.

PERMITTED PARKING CONFIGURATION DIAGRAMS	
	**Location A** *Parking permitted in 3rd Layer only* **1st Layer** – distance from right-of-way to front of building **2nd Layer** – 20 feet **3rd Layer** – remainder of lot
	**Location B** *Parking permitted in 2nd and 3rd Layers only* **1st Layer** – distance from right-of-way to front of building **2nd Layer** – 20 feet **3rd Layer** – remainder of lot
	**Location C** *Parking permitted in 2nd and 3rd Layers. Parking in 1st Layer restricted to one drive aisle with 2 bays.* **1st Layer** – distance from right-of-way to front of building **2nd Layer** – 20 feet **3rd Layer** – remainder of lot
	**Location D** *Parking permitted in 2nd and 3rd Layers. Parking in 1st Layer restricted to a driveway or paved surface not to exceed 40% of the lot width.* **1st Layer** – distance from right-of-way to front of building **2nd Layer** – 20 feet **3rd Layer** – remainder of lot
	**U** – *Unrestricted* **1st Layer** – distance from right-of-way to front of building **2nd Layer** – 20 feet **3rd Layer** – remainder of lot

9.4. PARKING REQUIREMENTS

Permanent off-street parking (including on-street parking in accordance with the requirements below) is required subject to the table below. If required, parking shall be provided at the time of erection, alteration, enlargement, establishment or change of use of any building or open use of land which require additional off-street parking. Mixed use developments or lots containing more than one use shall determine the total number of required parking spaces by adding together the required number of spaces for each of the proposed uses as if they were separate.

A. OFF-STREET PARKING SCHEDULE "A"

Use Category	Minimum Required Auto Spaces	Minimum Required Bicycle Parking Spaces[1]
Residential		
Dwelling-Single Family & Two Family	1 per unit, or 2 per unit if parking is provided in an enclosed garage	No requirement
Dwelling-Townhome & Multifamily	1.8 per unit	2 per 40 auto spaces
Dwelling-Accessory	1 per unit	No requirement
Live-Work Units	1 per 600 sf	2 per 40 auto spaces
Residential Care Facilities	1 per 2 resident rooms	2 per 40 auto spaces
All Other Residential Uses	No requirement	No requirement
Cluster Mailbox Unit	2 spaces per location, one space must meet ADA accessibility requirements	No requirement
Recreation facility, private (single-family dwellings or townhomes)	Subdivisions with 100 or more dwelling units shall provide: • 1 per 300 sf of clubhouse with interior gathering space • 1 per 100 sf of surface area of the pool (water area) • 2 per sports amenity (e.g., court, field, playground, park, etc.) Subdivisions with less than 100 dwelling units shall provide: • 1 per 300 sf of clubhouse with interior gathering space • 1 per 200 sf of surface area of the pool (water area) • 2 per sports amenity (e.g., court, field, playground, park, etc.)	4 spaces or 1 space per 30 dwelling units, whichever is greater
Recreation facility, private (multi-family)	No requirement	4 spaces or 1 space per 30 dwelling units, whichever is greater
Lodging – All Lodging Uses	1 per room	2 per 50 auto spaces
Office/Service		
Child/Adult Day Care Centers (More than 8 persons)	1 per 6-person capacity	2 per 50 auto spaces
Funeral Home	1 per 5 seats in chapel	2 per 50 auto spaces
Medical Clinic	1 per 250 sf	2 per 50 auto spaces
Office	1 per 300 sf	2 per 50 auto spaces
Veterinary Services	Schedule B	2 per 50 auto spaces
All Other Office/Service Uses	1 per 500 sf	2 per 50 auto spaces
Commercial		

Use Category	Minimum Required Auto Spaces	Minimum Required Bicycle Parking Spaces[1]
Restaurant Bar/Tavern Nightclub	1per 200 sf (minimum of 8)	2 per 50 auto spaces
General Commercial	1 per 350 sf	2 per 40 auto spaces
General Commercial – Greater than 100,000 sf	1 per 300 sf	2 per 40 auto spaces
Shooting range, outdoor	1 space per target and 1 space for every 300 sf of office area	2 per 50 auto spaces
All Other Commercial Uses	1 per 400 sf	2 per 40 auto spaces
Automotive	Schedule B	2 per 50 auto spaces
Entertainment/Recreation		
Amusements (Indoor)	1 per 4 persons permitted	2 per 40 auto spaces
Amusements (Outdoor)	1 per 4 persons permitted	2 per 40 auto spaces
Recreational Facility (Indoor)	1 per 4 persons permitted	2 per 40 auto spaces (minimum of 4 racks)
Recreational Facility (Outdoor)	Schedule C	4 spaces or a minimum of 2 per 40 auto spaces (minimum of 4 racks)
Sports Arena/ Stadium	Schedule C	2 per 40 auto spaces
Theater (Indoor & Outdoor)	1 per 5 seats	2 per 40 auto spaces
All Other Entertainment/Recreation Uses	Schedule C	2 per 40 auto spaces
Civic/Educational/Institutional		
Civic Meeting Facilities	1 per 100 sf	2 per 50 auto spaces
Community or Cultural Facility	1 per 300 sf	
Hospital	1 per 2 beds plus 1 per employee	2 per 50 auto spaces
Religious Institution (RA-HC, NMX, UMX)	No requirement	2 per 50 seats
Religious Institution (All Other Districts)	1 per 4 seats in the main assembly hall	2 per 50 seats
Schools – Elementary & Secondary	1 per 4 seats in the main assembly hall or gymnasium*	2 per 50 students
Studio – Art, dance, martial arts, music	1 per 400 sf	2 per 20 auto spaces
Vocational School/Technical	Schedule C	2 per 50 auto spaces
All Other Civic/Educational/Institutional Uses	Schedule C	2 per 40 auto spaces
Industry/Wholesale/Storage		
All Industry/Wholesale/Storage Uses	Schedule B	2 per 50 auto spaces
Agricultural		
Garden or Nursery	1 per 1,000 sf of open-air sales plus space for retail sales per Schedule B	2 per 50 auto spaces
Kennel, Outdoor	Schedule B	2 per 50 auto spaces
All Other Agricultural Uses	Schedule C	No requirement
Infrastructure – All Infrastructure Uses	Schedule C	No requirement

[1] Bicycle parking minimums are basked on the number of automobile parking spaces provided on site, not the minimum number of automobile parking spaces required.

B. OFF-STREET PARKING SCHEDULE "B"

Activity	Minimum Required Auto Spaces
Office or administrative area	1 per 300 sf
Indoor Sales Area	1 per 200 sf
Outdoor sales or display area (3,000 sf or less)	1 per 750 sf
Outdoor sales or display area (Over 3,000 sf)	
Motor vehicles/equipment sales	1 per 2,000 sf
Other sales/display	1 per 1,000 sf
Indoor Storage/warehousing	
1-50,000 sf	1 per 1,500 sf
50,001and greater sf	1 per 2,000 sf
Vehicle Service/manufacturing area	
1-3,000 sf	1 per 250 sf
3,001-5,000 sf	1 per 500 sf
5,001-10,000 sf	1 per 750 sf
10,001-50,000 sf	1 per 1,250 sf
50,001 and greater sf	1 per 2,000 sf

C. OFF-STREET PARKING SCHEDULE "C"

Uses that are not listed in Schedule A or that reference Schedule C have widely varying parking and loading demand characteristics, making it impossible to specify a single off-street parking or loading standard. Upon receiving a development application for a use subject to Schedule C standards, the Administrator shall apply the off-street parking and loading standard specified for the listed use that is deemed most similar to the proposed use, or shall establish minimum off-street parking requirements based on a parking and loading study prepared by the applicant. Such a study must include estimates of parking demand based on recommendations of the Institute of Traffic Engineers (ITE), or other acceptable estimates as approved by the Administrator, and should include other reliable data collected from uses or combinations of uses that are the same as, or comparable with, the proposed use. Comparability will be determined by density, scale, bulk, area, type of activity, and location. The study must document the source of data used to develop the recommendations.

9.4.1. Maximum Parking

The minimum parking requirements above have intentionally been set below general market expectations as a means to mitigate against the negative aspects of paved surfaces on the environment such as excessive water runoff, water pollution, and urban heat island effect. To this end, there shall also be a maximum parking standard for large parking facilities as follows:

A. Pervious Pavement Required

1. If a parking lot exceeds 150 spaces and includes more than twice the minimum number of spaces established for a use, as outlined in Section 9.4.1 above, any parking spaces over twice the minimum required must be installed using pervious pavement systems only.
2. If there are no minimum parking requirements for the use given in Section 9.4.1 above, the maximum parking standard shall be 35% of the site area.
3. Where poorly draining soil types prevent the use of this technique, the Administrator may grant an exception to the maximum parking standard above

upon sufficient justification from the applicant of the need for such extra parking facilities.

9.4.2. Exemptions, Exceptions and Adjustments

A. **Exemptions:** All uses in the RA-HC District are exempt from providing the minimum, off-street, automobile parking, required by the section. Bicycle parking is required as outlined in Section 9.4.A, based on the minimum of automobile spaces that would otherwise be provided.

B. **Exceptions for Non-Residential Uses in the Renaissance Area:** Nonresidential uses, located outside of the RA-HC district, in the Renaissance Area of downtown (as defined by the Renaissance Plan for Downtown Wake Forest, NC, dated September 2017, and as amended), may reduce the required off-street, automobile parking spaces, required in this Chapter, by up to 50% with Administrator approved provided the following are met:

1. The remaining number of required off-street parking spaces must be provided on-site, within a shared parking area (Section 9.4.3), a satellite parking area (Section 9.4.4), or by adjacent on-street parking (Section 9.4.2.D);
2. If a mixed-use development is proposed, the total number of required residential spaces must be provided; and
3. Additional bicycle parking, over and above what is required by Section 9.4.A, is required. A minimum increase of 50%, ~~but not less than two (2) Type I or Type II~~ long-term bicycle spaces shall be provided.

C. **Exceptions for Residential Uses in the Renaissance Area:** Residential uses, located outside of the RA-HC district, in the Renaissance Area (as defined in the Renaissance Plan for Downtown Wake Forest, NC, dated September 2017 and as amended), may utilize the following methods to either reduce the amount of space required for parking or to reduce the number of off-street parking spaces required in this Chapter by no more than 10%. Administrator approval is required.

1. Tandem Parking: Tandem parking is permitted for single-unit, two-unit, and multi-unit residential dwellings. Each tandem space must measure at least 9 feet in width by 36 feet in length. Both parking spaces in tandem must be assigned to the same dwelling unit. Guest parking, if provided, may not utilize tandem parking.
2. Private Car Sharing Program: The parking requirements for all dwelling units may be reduced by three (3) parking spaces for each car-share vehicle provided as part of an active on-site car-sharing program made available for the exclusive use of residents of multi-family dwelling developments. The total number of required spaces may not be reduced by more than 10% utilizing this method.

D. **Adjacent On-Street Parking:** In the Renaissance Area (as defined in the Renaissance Plan for Downtown Wake Forest, NC, dated September 2017 and as amended), public, off-site, on-street parking spaces, located immediately adjacent to the property line of any give site, may be counted as a parking space to meet the minimum parking requirements of this Chapter. These on-street parking spaces shall not be reserved or signed as parking for a particular use or site. Further, a note shall be added to the plans indicating these spaces are only to be counted for meeting the parking requirements on that particular development and in no way shall be counted toward any other development's off-street parking requirements.

E. **Adjustments for Tree Preservation:** The minimum number of parking spaces required may be adjusted by the Administrator when it has been determined that the reductions are necessary to preserve a healthy tree or trees (with a 12 inch or greater

diameter at breast height) from being damaged or removed, and where the site plan provides for the retention of said tree or trees.

9.4.3. Shared Automobile Parking

A. One parking lot may contain required parking spaces for several different uses; however, the required parking spaces assigned to one use may not be counted or assigned to another uses, unless otherwise provided in this section.

B. To the extent that developments that wish to make joint use of the same parking spaces operate at different, off-peak times, the same spaces may be credited to both uses.

C. In the joint use of the same parking spaces by two or more principal uses involves satellite parking spaces, then the provisions of Section 9.4.4 are also applicable.

D. Where vehicle access is provided between adjoining nonresidential developments and the operating hours of adjoining uses do not significantly overlap, the uses may share up to 50% of the required parking spaces.

E. An applicant proposed the use of the shared parking must:

1. Demonstrate that the applicant has the express legal right to use the parking spaces in question;
2. Provided the shared use parking agreement detailing how the parking spaces will be shared among the uses; and
3. Sign an acknowledgement that the continuing validity of the applicant's development permit depends upon the continuing ability to provide the requisite number of parking spaces. I the shared parking is no longer available or the property owner fails to comply with the requirements of this section, the parking requirement revers to those requirements found in the table in Section 9.4.A and the property owner or applicant must demonstrate compliance with said requirements or the development permit shall be revoked.

F. Should there be a change in owner, change in use, expansion or reduction in building or parking area, a new shared use agreement and agreement in outlined in subsection E above shall be submitted to the Town and additional parking may have to be provided as required by this Ordinance or the permit shall be revoked.

9.4.4. Satellite Automobile Parking

A. If the off-street parking spaces required by this section cannot be reasonably provided on the same lot on which the principal use is located, such space may be provided on any land within 660 feet. Such measurement shall be taken from the edge of the satellite parking area to the entryway of the principal use for which the parking is provided. A safe, direct, paved, and lit pedestrian routed shall be provided between the lot and the entrance of the principal use.

B. Satellite parking may not be used for residential visitor/guest parking or for the provisions of the ADA required spaces unless located within 200 feet of the entryway of the principal use for which the parking is provided.

C. If satellite parking is utilized to fulfill parking requirements, the owner or authorized agent for the land upon which such satellite parking is located shall restrict the use of such parking area for parking only in connection with the use(s) or structure(s) for which such satellite parking is provided. Such restriction shall be recorded through an easements plat properly filed with the Register of Deeds of Wake County, which may be released only by written consent of the town.

D. Satellite parking for a particular use shall not be established in any district that does not allow that use.

E. The applicant wishing to utilize the provisions of this section must present satisfactory written evidence that the applicant has the legal right to use the satellite parking spaces, and that such right is exclusive during the operation hours of the use in question. The applicant must also sign an acknowledgement that the continuing validity of the applicant's permit depends upon the continuing ability to provide exclusive use during operation hours of the requisite number of parking spaces. If the parking spaces are required for residential uses, "operating hours" shall be considered 24 hours a day for the purposes of this section.

F. The applicant using satellite parking to comply with the requirements of this section must sign an acknowledgement that the continuing validity of the applicant's permit depends on the continuing ability to provide the requisite number of parking spaces. If the applicant or property owner fails to comply with the requirement so this section, the parking requirements reverts to those requirements in this Chapter and the property owner and applicant must demonstrate compliance with said requirements or the development permit may be revoked.

G. Should there be a change in owner, change in use, expansion or reduction in building or parking area, the applicant will have to demonstrate continued compliance through the satellite parking and/or provide additional parking as required by this Ordinance or the permit shall be revoked.

9.4.5. Off-Street Loading Requirements

A. **Off-Street Loading Schedule:** Off-street loading spaces shall be required for industrial, major institutional, and business uses that can be expected to regularly receive or deliver goods, pursuant to the following Off-Street Loading Schedule (RA-HC is exempt from this requirement)

Gross Floor Area (Square Feet)	Required Number of Spaces
0-20,000	0
20,001 - 40,000	1
40,001 - 100,000	2
100.001 - 160,000	3
160,001 - 240,000	4
240,001 - 320,000	5
320,001 – 400,000	6
Each 90,000 over 400,000	1

B. **Dimensions:** Required loading spaces shall have the following minimum dimensions: 12-foot minimum width, 25-foot minimum length, and 14-foot minimum vertical clearance.

C. **Locations:**

1. Required off-street loading spaces shall not be located within a building, but shall be on the site of the use served or on an adjoining site.
2. Required off-street loading spaces shall be located to the sides and/or rear of the lot to maximize the street exposure of the primary structure.
3. A loading area shall not be located in a required setback. In addition, street-side loading docks shall be set back at least 70 feet from the street property line or 110 feet from the street center line, whichever is greater.
4. No loading bay may intrude into any portion of a required parking aisle or access dimension.

D. **Access:**

1. A required loading stall shall be accessible without parking a truck across a street property line unless the Administrator determines that provision of turn-around space is infeasible and approves alternate access.
2. An occupied loading space shall not prevent access to a required off-street parking space.Loading areas visible from a street shall be screened on three sides by a solid, decorative fence, wall, or hedge at least six feet in height.

9.5. VEHICLE PARKING DESIGN STANDARDS

9.5.1. Parking Area General Design Standards

A. Parking areas shall be located and designed to avoid undue interference with the use of public rights-of-way, driveways, or pedestrian ways. Parking stalls shall not be located in areas that would require backing into access driveways or streets except where allowed for residences.

B. Parking design and location shall be in accordance with the Wake Forest Manual of Specifications, Standards and Design (MSSD).

C. Parking stalls shall be located a minimum of 10 feet from public rights-of-way and buildings to allow sufficient separation for sidewalks, landscaping and other site features except along the backs of buildings in areas designed for loading and unloading.

D. Parking shall not be located in landscaped, open space or tree save areas.

E. Parking areas shall be maintained to provide for vehicle access and shall be kept free of litter, debris, outdoor display and sales and material storage, including portable containers.

F. Parking for service vehicles shall be designated, located and screened to minimize the view from adjacent properties and rights-of-way, generally at the rear of buildings.

G. Vehicle storage or display areas shall be identified on the site plan distinct from customer and employee parking areas and shall comply with parking access, location and design requirements, except that striping of the display or storage area shall not be required. Vehicle storage or display areas shall not be located in a manner that interferes with vehicle or pedestrian access aisles or driveways.

H. Tractor trailers, cargo trucks, busses and other large commercial vehicles or heavy equipment parking and storage shall comply with parking access, location and design requirements except for stall size and aisle size which shall be as appropriate for the vehicles to be stored and shall be designated on a site plan.

9.5.2. Off-Street Parking Area Design Standards

~~I.~~A. Pavement directional arrows shall be provided on one-way driveways, one-way drive aisles, drive aisles with angled parking, and locations warranted by the Administrator for safety and traffic operations.

~~J.~~B. Loading areas and off-street parking spaces shall be marked with pavement surface markings so that they are easily identified.

~~K.~~C. Stop bars, directional arrows, crosswalks, and any regulatory pavement markings required by MUTCD.

~~9.5.2.~~9.5.3. Surfacing Materials

Off-street parking areas shall be properly graded, marked and located on improved lots or within parking structures. The material for surface parking spaces and corresponding access drives required by this section, except for single-family detached and duplex residences, shall consist of suitable material as set forth below.

A. **Suitable Materials:** Suitable paving materials for parking areas include, but are not limited to, asphalt, porous asphalt, porous paving blocks, and concrete.

B. **Accessible Spaces:** All accessible spaces and corresponding access paths shall consist of concrete or asphalt.

C. **Gravel:** When gravel is used it must be maintained on site with a concrete apron at the traveled way.

D. **Pervious Surfaces:** Porous paving blocks and pervious paving materials are permitted and encouraged as material for parking lots. The use of reinforced grass as a parking lot surface is permitted for satellite parking areas.

E. **Parking Space Marking:** The individual parking spaces in a lot shall be delineated in all parking lots except those utilizing road bond, gravel, grass or other vegetative surfacing.

F. **Exceptions to Paved Parking**: An overflow parking lot used only for occasional use (Use that occurs on two or fewer days per week) or is temporary in nature (not exceeding 6 months) is exempted from the requirements of this Section.

1. Off-street areas used for special event parking (to accommodate occasional overflow volumes) may be constructed of any dust-free and compacted ground cover. The owner of the property shall be responsible for the maintenance of such parking areas in a clean and dust-free condition. Grass, gravel, and mulch are examples of acceptable ground cover.

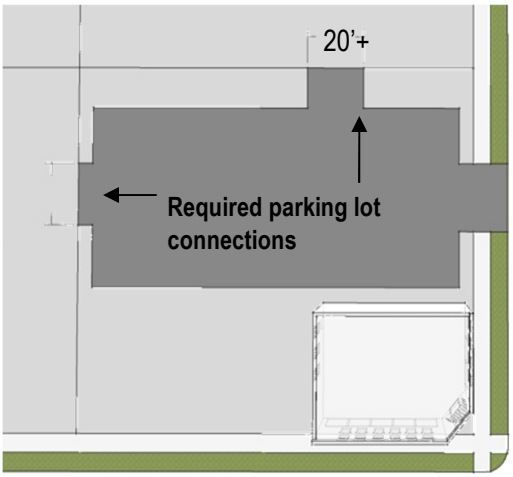
G. **Non-Paved Areas:** Whenever a permanent parking area is exempt from the paved parking requirements or otherwise not required to be paved, the Administrator shall:

1. Require that landscape aisles or spatial separations be provided where the Administrator finds it is desirable to ensure that the parking spaces will be readily identifiable to the users; and
2. Require the perimeter of the vehicle accommodation area encompassing the parking stalls and the side of any unpaved drive or aisle leading to said stalls, to be edged with brick, pressure treated timbers, or cast in place concrete, and anchored into place. Alternate borders may be considered on a case by case basis.

~~9.5.3.~~9.5.4. Connectivity

A. Adjoining parking lots serving (or potentially serving) non-residential or multi-family uses shall be interconnected as follows: (See illustration below)

1. The parking lot under development has a minimum of 24 parking spaces or equivalent parking area.
2. At least 1 connection is provided at all lot lines that are coincident for at least 60 feet with another lot zoned for non-residential use.
3. The connection is at least 20 feet wide.
4. If applicable, the connection aligns with a connection that has been previously constructed on an adjacent property.
5. The connection has a slope of no greater than 15 percent.



6. The connection is not placed where a building on an adjacent property is within 50 feet of the lot line which would hamper traffic movements within the parking lot.
7. The connection is placed in an area which will not require the removal of significant natural features such as wetlands or trees with a caliper of 6 inches or more.
8. In the event these conditions cannot be met without undue hardship, or if such connections would create undesirable traffic flow, the Administrator may waive the connection requirement.

B. Where a parking lot connection is required an easement for ingress and egress to adjacent lots shall be recorded by the property owner with the Wake County Register of Deeds in the form of an easement plat.

~~9.5.4.~~9.5.5. Structured Parking

A. **Screening Required:** Where an above-ground parking structure fronts a public street, the ~~ground level~~ side facing the street shall be screened in such a way that cars are not visible from the street. ~~(e.g., structure could be wrapped by retail, office or some other active use along the primary façade).~~

B. **Materials:** Along pedestrian-oriented streets, parking structure façades shall be treated with high quality materials and given vertical articulation and emphasis compatible with the principle structure. The façade shall be designed to visually screen cars.

C. **Entries:** Pedestrian entries shall be clearly visible.

D. **Bicycle Parking:** Parking structures shall provide bicycle parking within the structure. It shall be located on the level closest to the street and/or a primary building entrance.

9.6. BICYCLE PARKING STANDARDS

~~**9.6.1. Bicycle parking shall be provided by all non-residential, multi-family, recreation and industrial uses. Bicycle parking facilities required by this section shall be designed to provide convenient bicycle parking and to protect parked bicycles from damage. Acceptable rack elements, rack location and access, rack area and site conditions such as protection from the elements and visibility shall conform to the Association of Pedestrian and Bicycle Professionals Bicycle Parking Guidelines.**~~

9.6.1. General Provisions

A. Permanent off-street bicycle parking is required subject to the Off-Street Parking Schedule "A" in Section 9.4.A.

B. Bicycle parking must be conveniently located and publicly accessible. Sidewalk will need to connect the bicycle parking facility to the rest of the pedestrian network.

9.6.2. ~~Bicycle Parking Facilities~~ Short-Term Bicycle Parking

A. Short-term bicycle parking provides customers and other visitors a convenient and readily accessible place to park. Required short-term parking must meet the following standards.

1. Short-term parking shall be located outside the building and located near the building entrance or use it is intended to serve.

9.6.3. Long-Term Bicycle Parking

A. Long-term bicycle parking provides employees, students, residents, commuters, and others who generally stay at a site for several hours a protected and secure place to park.

B. Multi-family developments shall meet the required minimum bicycle parking with long-term bicycle facilities.

C. Required long-term parking must meet the following standards.

1. Long-term bicycle parking shall be covered and weather resistant.
2. Long-term bicycle parking shall be located near the building entrance it is intended to serve.
   a. Long-term bicycle parking serving non-residential use may be located within an internal area accessible by all occupants of the building.
   b. Long-term bicycle parking may be located within an internal area accessible by the public (such as bike locker room) or located in stairwells. Storage within a multi-family dwelling unit would not be considered a long-term bicycle parking space.

~~Bicycle parking spaces shall be Class I, Class II, or Class III facilities. Racks which only support one wheel are not acceptable.~~

~~**C. Class I:** Bicycle lockers are generally rectangular enclosures, each holding one or 2 bicycles.~~

~~**D. Class II:** Bicycle parking racks which allow all 3 major components of the bicycle, back wheel, frame, and front wheel, to be locked, without removal of the front wheel.~~

~~**E. Class III: Racks such as loop, post, rails, "A" and inverted "U" racks. Each rack provides 2 bicycle parking spaces. Common properties in a class III facility include its support of the bicycle with or without the front wheel removed and post or pipe dimensions which allow the lock to encompass the front tire and down post or the rear wheel and seat post. Class III facilities are recommended for short-term parking, although, in combination with shelter, they can be adequate for long-term storage.**~~

"Inverted U" bicycle rack

~~9.6.2.~~9.6.4. ~~General~~ Bicycle Parking Design Standards

~~**A. Multi-Family Development**: Required bicycle parking spaces in multi-family development shall be provided in Class I facilities, or in Class II or III facilities if shelter is provided to accommodate long-term storage. If completely enclosed garages or accessory storage structures of at least 8 feet by 6 feet that may be locked or otherwise secured by individual tenants are provided for every unit in a multi-family development, no additional bicycle parking shall be required.~~

A. Surfacing

1. ~~:~~Bicycle parking shall be provided on a hard-surface, all-weather pavement of asphalt or concrete. ~~with curb ramps installed as appropriate.~~

~~**B.**~~

~~**C. Signage**: Where not clearly visible from the access way, directional signage shall be provided to route bicyclists to the bicycle parking facility.~~

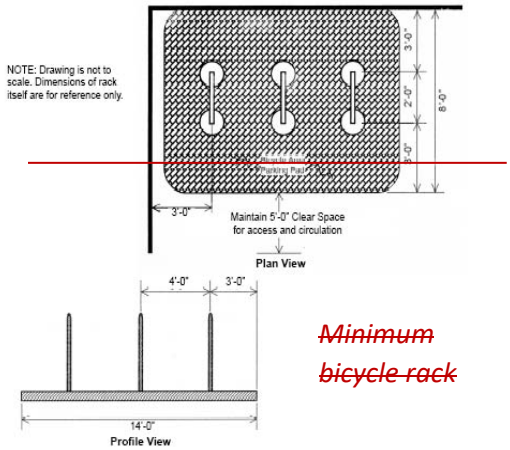
~~**D. Installation**: Installation shall be according to the manufacturers' instructions.~~

B. Placement~~:~~

1. Bicycle parking shall be located as to not interfere with pedestrian access.~~:~~
2. Proposed bike parking facilities must comply with siting standards set forth in the MSSD.
3. ~~E.~~ Bicycle parking shall be located 3 feet away from walls, fences, and the edge of landscaping at the time of maturity, as measured from the edge of the rack close to the wall, fence, or landscaping.

~~1. Separated from automobile parking by a physical barrier or by at least 5 feet where automobile parking is prohibited and shall be located as close to public and employee entrances as possible without interfering with the flow of pedestrian and vehicular traffic.~~

~~2. Conveniently located near entrances (where multiple entrances exist, the racks shall be dispersed among the entrances rather than located in large groupings)~~



~~*Minimum bicycle rack*~~

~~Located so as not to interfere with pedestrian access.~~

~~Covered wherever possible.~~

C. Rack Types

1. ~~:~~Grid bicycle racks shall not be permitted.
2. ~~3.~~ Bicycle lockers or similar types of facilities are permitted and count towards required parking standards.

9.7. TRANSPORTATION FACILITY PERMITS

A Transportation Facility (TF) is any surface parking lot of 1500 spaces or more, a combination of surface and structure parking of 1000 spaces of more, or any parking structure of 750 spaces. Transportation Facilities must comply with the regulations pertaining to the TF Program administered by the North Carolina Department of Environmental and Natural Resources, Division of Air Quality. Any existing facility that plans a modification that exceeds the above threshold is subject to the TF Program regulations.

9.8. Driveway Access

9.8.1. Driveway Standards

Any use which requires lowered or cutaway curbs, for purposes of ingress or egress, shall be subject to the provisions below.

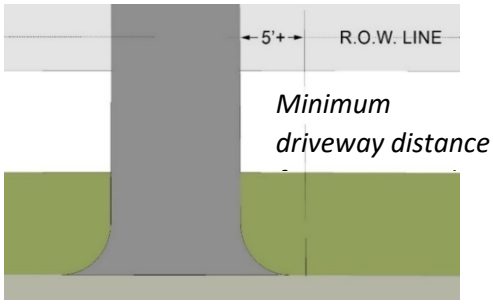
A. Single-Family Residential Lots:

Frontage Width	Maximum Permitted Driveways
Less than 50 feet	1
More than 50 feet	2
For residential properties, the requirements of Section 5.5.4 shall also apply.	

B. **Non- Residential Driveways:** The maximum number of combined entrances and exits allowed on any parcel shall correspond to the frontage of that parcel on any one street as indicated in the following table, except that properties with frontage on major access corridors in the Special Highway Overlay Districts shall be subject to the driveway requirements of Section 4.3.4.E.

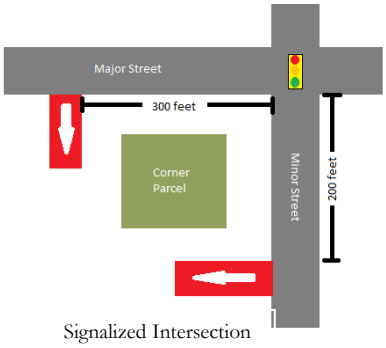
Frontage Width	Maximum Permitted Driveways
Less than 500 feet	1
501 – 1200 feet	2
More than 1200 feet	3
Additional entrances or exits shall be permitted after showing of actual requirements of convenience and necessity and upon approval of the Board of Commissioners.	

C. **Location of Driveway Access Points**

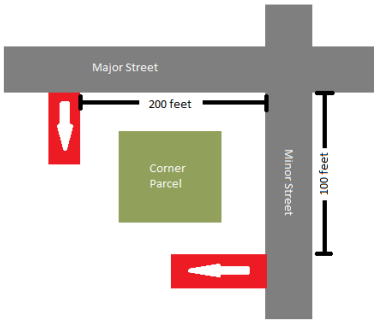


1. All non-shared access driveways shall be constructed to be at least 5 feet from any property line at the right-of-way, except that a curb return may become tangent to a curb line at a point where said property line extended intersects said curb line.
2. Driveways shall be located at a point along the frontage where it is possible for drivers of vehicles entering the highway to see in both directions along the traveled way far enough to allow entering the roadway without creating a hazardous situation.
3. Consideration of adjacent public/private streets and other driveways shall be used to prevent closely spaced driveways to adjacent properties and favor a more centralized driveway(s) to promote connectivity.
4. The Town reserves the right to permit access where it deems appropriate for the operational needs of the site and existing infrastructure. There is no guarantee of access to the applicant's preferred driveway location or access point.
5. Access may be restricted to less than a full access movement. Any required infrastructure improvements may be required as a condition of the site plan in addition to the required improvements of Section 6.5.
6. Along Major roadways the minimum distance between any 2 driveways/curb cuts on the same side of the street shall be not less than 200 feet.
7. At signalized street intersections, no driveway/curb cut shall be located within 300 feet of the intersection on Major Roadways and 200 feet on Minor/Local Streets.

8. At unsignalized street intersections, no driveway/curb cut shall be located within 200 feet of the intersection on Major Roadways and 100 feet on Minor/Local Streets.



Signalized Intersection



Unsignalized Intersection

D. **Driveway Channelization**: Adequate driveway channelization is required in order accommodate the operations needs of the development while protecting the functionality of the intersection. Protected driveway channelization assists with traffic organization of entering and exiting traffic while preventing excessive maneuverability and cross-traffic close to the intersection. All developments are required to provide a minimum of fifty feet (50') of minimum channelization (from the edge of pavement on the intersecting roadway) prior to any internal driveways, cross access or direct parking areas. For larger commercial developments and high-density mixed-use developments, a minimum of one-hundred feet (100') will be required. Driveways that are served by a signalized intersection, a minimum of two-hundred feet (200') of protected channelization is required or beyond the limits of storage required by the signal, whichever is larger.

E. **Driveway Vehicle Storage Space**: Adequate internal storage space shall be provided for all driveways for all services that required drivers to remain in their vehicles. This may include, but is not limited to, school drop-off and pick-up, banks, ATMs, and drive-thru's. Specific storage requirements will be made on a case-by-case basis based on the development and services to be provided.

At a minimum the following vehicle storage shall be provided. A storage space of twenty-five feet (25') per vehicle shall be used for passenger vehicles.

Type of Service	Minimum Storage Capacity
Single-Lane Bank/ATM	6 vehicles
Multi-Lane Bank/ATM	4 vehicles per lane
Full Service Car Wash	12 vehicles
Automatic/Multi-Service Car Wash	4 vehicles per lane
Food/Drink Services	8 vehicles per lane (measured from the menu/ordering board)
Fuel/Gas Pumps	A minimum of 30 feet of storage measured from the island for all pumps

F. **Driveway Width**: Driveway width measurements pertain to the measurement of the driveway at the sidewalk. At other points in the driveway the width may vary.

1. Single Family Detached Residential Driveways: Driveways on detached single family residential properties shall have a minimum width of 12 feet and shall not exceed a maximum width of 20 feet.

2. **All Other Driveways**: The width, in feet, of a driveway approach shall be within the minimum and maximum limits as specified below.
    a. One-way drives shall have a minimum width of 12 feet and shall not exceed a maximum width of 30 feet.
    b. Two-way drives shall have a minimum width of 16 feet and shall not exceed a maximum width of 36 feet.
3. **Public Service Driveways Exempt**: Driveways for fire protection, law enforcement, and other public services shall be exempt from the driveway width requirements of this paragraph.

G. Joint Use Driveway

1. Wherever feasible, the Administrator shall require the establishment of a joint use driveway serving 2 abutting properties.
2. When a property is developed before an abutting property is developed, the site shall be designed to ensure that its driveway and circulation may be modified to create a joint use driveway and interconnected parking with the abutting property at a later date.

H. Utility Driveways: A 10-foot-wide curb depression shall be provided at all locations where utilities cross curb and gutter to run into off-site easements. The purpose for the depression is to provide equipment access to easements without "hopping" over the curb.

I. Compliance with Local and State Requirements

1. Any person or corporation desiring to construct a driveway or other connection within the right-of-way of the town or state shall, before beginning any construction, secure the appropriate permits from the authorizing agency, allowing such construction. Driveway connections to residences are normally excluded from this requirement, but may be included at the option of the authorizing agency.
2. Failure to secure a permit prior to construction may result in the removal of the driveways and/or denial of access at that location.

J. Minor Roadway (See Section 6.8.2) and Driveway Sight Triangles

Town of Wake Forest follows the NCDOT standard of 10' x 70' in size along the intersecting rights-of-way, with the 70-foot dimension along the cross street. This sight triangle must be shown at all connections to a town or state- maintained roadway, regardless of street or driveway classification or dimension, and is located on each side of the approaching street or driveway classification or dimension and is located on each side of the approaching street or driveway. No object that impedes sight distance between a height of 30 and 72 inches (vehicle height) above the ground surface, shall be located within any of the sight distance triangle.

K. Major Roadway (See Section 6.8.2) and Driveway Sight Triangles

The Town follows AASHTO's recommendations for sight distance along major roadways. Access to major roadways shall provide adequate sight distance to avoid striking an unexpected object in the travel way. This length will vary based on design speed on the intersecting roadway, grade, and stopping sight distance of the vehicles on the intersecting roadway. All sight distance triangles shall be computed from the decision point of the vehicle entering the major roadway.

1. The table below lists the length of sight distance that should be used along the major roadways on grades 3% or less.

Design Speed (mph)	Length of Sight Distance (ft)
15	70
20	90
25	115
30	140
35	165
40	195
45	220
50	245
55	285
60	325
65	365

2. For roadway grades >3%, the following table shall be used. All distances are shown in feet perpendicular to the decision point.

Approach Grade (%)	Design Speed (mph)									
	15	20	25	30	35	40	45	50	55	60
-6	77	99	126.5	154	181.5	214.5	242	294	342	390
-5	70	90	126.5	154	181.5	214.5	242	269.5	313.5	357.5
-4	70	90	115	154	181.5	214.5	242	269.5	313.5	357.5
-3 to +3	70	90	115	140	165	175.5	198	220.5	256.5	325
4	70	90	115	140	148.5	175.5	198	220.5	256.5	292.5
5	70	90	115	126	148.5	175.5	198	220.5	256.5	292.5
6	70	90	103.5	126	148.5	175.5	198	220.5	256.5	292.5

15. Administration

15.1. Purpose and Intent

In order to establish an orderly process to develop land within the jurisdiction of the Town of Wake Forest consistent with standard development practices and terminology it is the purpose of this chapter to provide a clear and comprehensible development process that is fair and equitable to all interests including the petitioners, affected neighbors, Town Staff and related agencies, and the Board of Commissioners.

15.2. GENERAL PROVISIONS & APPLICABILITY

The provisions of this chapter shall be applicable to all development activity under the jurisdiction of the Town of Wake Forest.

15.2.1. No Construction To Commence Without Permit

No land shall be used or occupied and no structures shall be erected, moved, extended, or enlarged, nor shall any timbering, clearing and grubbing, or filling of any lot for the construction of any building be initiated until the Administrator has issued an appropriate permit which will certify that the proposed work is in conformity with the provisions of this ordinance.

15.2.2. Fees & Inspections

A. The Town of Wake Forest Board of Commissioners is authorized to establish fees to be charged by the town for the administration of the regulations in this ordinance. The town shall adopt as part of their annual budgeting process, a schedule of fees for applications and processing for permits as specified in this ordinance.

B. Agents and officials of the town are authorized to inspect land-disturbing activities to ensure compliance with this ordinance, or rules or orders adopted or issued pursuant to this ordinance, and to determine whether the measures required in approved development plans are being appropriately followed. Notice of the right to inspect shall be included in the certificate of approval of each Plan.

C. No person shall willfully resist, delay or obstruct an authorized representative, employee or agent of the Town while that person is inspecting or attempting to inspect a land-disturbing activity.

D. The Town shall also have the power to require written statements or filing reports under oath, with respect to pertinent questions relating to the land disturbing activity.

15.2.3. Development Review Process

See Appendix A – Typical Development Review Process Chart for more information regarding the timing of required applications/approvals.

15.2.4. Permit/Process Type

Permit/ Process Type	Section	Permit/ Process Type*	Reviewing Agency	Public Notice (15.3)	Approving Agency	Appeal Process	Permit Validity Period**	Permit Extension
Development Permit	15.6.1	Administrative	Admin	N/A	Admin	BOA	1 year	1 year
Temporary Use Permit	15.6.2	Administrative	Admin	N/A	Admin	BOA	See 4.7	See 4.7
Certificate of Completion	15.6.3	Administrative	Admin	N/A	Admin	BOA	N/A	N/A
Modification of Setbacks	15.6.4	Administrative	Admin	N/A	Admin	BOA	N/A	N/A
Tree Clearing Permit	15.7.1	Administrative	Admin	N/A	Admin	BOA	1 year	Re-submit
Land Disturbance Permit	15.7.2	Administrative	Admin	N/A	Admin	BOA	2 years	1 year
Floodplain Development Permit	15.7.3	Administrative	Admin	N/A	Admin	BOA	1 year	Re-submit
Site Master Plan	15.8.1	Administrative	Admin/TRC	N/A	Admin	BOA	2 years	1 year
Site Construction Plan	15.8.2	Administrative	Admin/TRC	N/A	Admin / TRC	BOA	2 years	1 year
Architectural Design Review	15.8.3	Administrative	Admin	N/A	Admin	DRB	1 year	N/A
Subdivision Master Plan	15.9.1	Administrative	Admin/TRC	N/A	Admin	BOA	2 years	1 year
Subdivision Construction Plan	15.9.2	Administrative	Admin/TRC	N/A	Admin / TRC	BOA	2 years	1 year
Final Plat	15.9.3	Administrative	Admin/TRC	N/A	Admin	BOA	30 days to file Plat	Re-submit
Special Use Permit	15.10	Quasi-Judicial	Admin/TRC	Levels 1, 2, 4 & 5	BOC	Superior Court	2 years	1 year
Designation of Historic Landmarks/Districts	15.11.1	Legislative	HPC	Levels 1, 2 & 3	BOC	Superior Court	N/A	N/A
Certificate of Appropriateness – Minor Works	15.11.2	Administrative	Admin	N/A	Admin	HPC	1 year	1 year
Certificate of Appropriateness – Major Works	15.11.3	Quasi-Judicial	Admin	Levels 1 & 3	HPC	BOA	1 year	1 year
Certificate of Appropriateness – Demolition of Historic Structures	15.11.4	Quasi-Judicial	Admin	Levels 1 & 3	HPC	BOA	1 year	1 year
Appeal of Administrative Decision	15.12	Quasi-Judicial	BOA	Levels 1 & 2	BOA	Superior Court	30 days to Appeal	N/A
Variance	15.13	Quasi-Judicial	BOA	Levels 1, 2 & 4	BOA	Superior Court	30 days to Appeal	N/A
Text Amendment	15.14	Legislative	PB	Levels 1 & 2	BOC	Superior Court	N/A	N/A
Map Amendment (Rezoning)	15.14	Legislative	PB	Levels 1, 2, 3, 4 & 5	BOC	Superior Court	N/A	N/A
Conditional Zoning	15.15	Legislative	PB	Levels 1, 2, 3, 4 & 5	BOC	Superior Court	N/A	N/A
Planned Unit Development Rezoning	15.16	Legislative	PB	Levels 1, 2, 3, 4 & 5	BOC	Superior Court	N/A	N/A
Comprehensive Plan Amendment	15.17	Legislative	PB	Levels 1 & 2	BOC	Superior Court	N/A	N/A

Permit/ Process Type	Section	Permit/ Process Type*	Reviewing Agency	Public Notice (15.3)	Approving Agency	Appeal Process	Permit Validity Period**	Permit Extension
Annexation and ETJ Expansion	15.18	Legislative	Admin	Levels 1 & 2	BOC	Superior Court	N/A	N/A
Admin – Administrator (14.1) | BOC – Board of Commissioners (14.2) | TRC – Technical Review Committee (14.3) | PB – Planning Board (14.4) BOA – Board of Adjustment (14.5) |HPC – Historic Preservation Commission (14.6) | DRB – Design Review Board (14.7) {} | Superior Court of North Carolina *All Legislative and Quasi-Judicial Permit/Process Types shall require a public hearing according to the provisions outlined in this chapter for each process. **Requests for vesting must be made at the time the application is submitted. Development meeting NC General Statute requirements for multi-phase development vesting plan may be eligible for extended vesting rights. Developments identified as site specific vesting plans are vested for a period of two years.								

15.2.5. Completeness Review

A. **Sufficiency to be Determined by Administrator:** All applications shall be sufficient for processing before the Administrator is required to review the application. An application shall be sufficient for processing when it contains all of the information necessary, in accordance with the appropriate development permit checklist, to decide whether or not the development as proposed will comply with the requirements of this ordinance. The Administrator will prepare and disseminate appropriate checklists for use by applicants in their submission. These checklists are located on the Town of Wake Forest website and are made a part of this ordinance by reference.

B. **Application Information:** The presumption shall be that all of the information required in the application forms is necessary to satisfy the requirements of this section. However, it is recognized that each application is unique, and therefore more or less information may be required according to the needs of the particular case.

C. **Evidence of Authority:** The Administrator may require an applicant to present evidence of authority to submit the application. Applications for development approvals may be made by the landowner, a lessee or person holding an option or contract to purchase or lease land, or an authorized agent of the landowner. An easement holder may also apply for development approval for such development as is authorized by the terms of the easement.

D. **Application Deadline:** Applications sufficient for processing shall be submitted to the Administrator in accordance with the published calendar schedule. Schedules indicating submittal dates shall be developed each year and made available to the public.

E. **Resubmittal Deadline:** Upon receiving review comments from staff or TRC, revised applications shall be resubmitted no later than six months from the date of the comments. If a revised application is not resubmitted within the stated timeframe, the application will be considered withdrawn and a new application and review fee shall be submitted.

15.3. PUBLIC NOTIFICATION

The following procedures have been established for development applications/petitions that require notification of the public prior to consideration and/or approval.

15.3.1. Level 1 – Sunshine List

A notice of the pending application/meeting shall be posted in a prominent location in Town Hall and on the town's web site, and a notice of such meeting shall be mailed, e-mailed, or delivered to each person and media provider that has filed a written request for notice with the Town Clerk. This notice shall be posted and mailed, e-mailed,

or delivered at least 48 hours before the time of the meeting. Notices shall be distributed by email. Non-media members of this list shall be charged an annual fee (as set in the fee schedule) to receive all notices by mail. Members of this distribution list must renew their participation in this distribution on an annual basis.

15.3.2. Level 2 – General Notice In Newspaper

A notice shall be published in a newspaper of general circulation in the town once a week for 2 successive weeks, unless the notice is for an annexation public hearing which requires a single notice. The first publication shall appear no less than 10 days or more than 25 days prior to the date fixed for the legislative or evidentiary public hearing. The notice shall include the time, place and date of the hearing/meeting and include a description of the property and the nature of the proposal.

15.3.3. Level 3 – Notification To Affected Property Owners

A. **Mailed Notice:** The owners of all property affected by a pending action (e.g., new overlay district) shall be notified of the hearing/meeting by first class mail. Such notification shall be postmarked at least 10 but not more than 25 days prior to the date to the meeting at which the matter is to be heard.

B. **Published Notice – Full Community Notification:** As an alternative, to the mailed notice requirements in the above paragraph, the town may elect to serve notice through a full community notification for pending actions that affect at least 50 properties with at least 50 different property owners. The town shall publish notice of the hearing/meeting in a newspaper of general circulation in the town. Two advertisements shall be published in separate calendar weeks. Each advertisement shall not be less than one-half of a newspaper page in size. The advertisement shall only be effective for property owners who reside in the area of general circulation of the newspaper which publishes the notice. Property owners who reside outside of the newspaper circulation area, according to the address listed on the most recent property tax listing for the affected property, shall be notified by first class mail.

C. **Posted Notice:** In addition to providing mailed notice or published notice, as required in paragraphs A and B above, a sign shall be placed in a prominent location on the subject property(ies) or on an adjacent public street or highway right-of-way with a notice of the pending action and a phone number to contact for additional information.

D. **Additional Requirements for Third Party Re-Zonings:** Except for a town-initiated zoning map amendment, when an application is filed to request a zoning map amendment and that application is not made by the owner of the parcel of land to which the amendment would apply, the applicant shall certify to the Board of Commissioners that the owner of the parcel of land as shown on the county tax listing has received actual notice of the proposed amendment and a copy of the notice of legislative or evidentiary public hearing. The applicant shall certify that proper notice has been provided in fact, and such certificate shall be deemed conclusive in the absence of fraud. If notice cannot with due diligence be achieved by personal delivery, registered or certified mail, or by a designated delivery service authorized pursuant to 26 U.S.C. §7502(f)(2), notice may be given by publication consistent with G.S. 1A-1, Rule 4(j1). This applies only to an application to request a zoning map amendment where the application is not made by the owner of the parcel of land to which the amendment would apply. Except for a town-initiated zoning map amendment, third-party down-zonings are prohibited.

15.3.4. Level 4 – Notification To Adjacent Property Owners

The owners of property within 500 feet on all sides of the subject property shall be notified of the hearing/meeting by first class mail. Such notification shall be postmarked at least 10 but not more 25 days prior to the date of the meeting at which the matter is to be heard. In addition, a sign shall be prominently posted on the subject property(ies) or on an adjacent public street or highway right-of-way with a notice of the pending action and a phone number to contact for additional information.

15.3.5. Level 5 – Neighborhood Meeting

The applicant shall conduct a neighborhood meeting where required in Section 15.2.4 prior to any legislative or evidentiary public hearing or review by an approving board or commission. This meeting will allow the applicant to explain the proposed project and to be informed of the concerns of the neighborhood and surrounding property owners. The neighborhood meeting shall be held after the first round of staff review has been completed and prior to application resubmitted for the second round of staff review.

A meeting notice shall be sent to property owners and Homeowner Associations within 500 feet of the proposed development. The notice shall be sent by first class mail and be postmarked at least 10 but not more than 25 days prior to the date of the neighborhood meeting. A copy of the notice shall also be sent to the Planning Department. The letter shall contain a summary of the proposed development, the applicant's contact information, the date, time and location of the meeting. The location of the neighborhood meeting should be held within a reasonable distance of the proposed project. The meeting shall be held at a reasonable time giving the nearby property owners an opportunity to attend. A summary of the meeting in the form of meeting notes or minutes along with a list and contact information for all attendees shall be submitted to the approving board or commission for their review at all subsequent legislative or evidentiary hearings.

15.4. APPLICATION REQUIREMENTS

The following general standards for various applications have been identified as a means to create a hierarchy of submissions for various permits and procedures. It is the expressed intent of this ordinance to limit the required information to only that data/information that is necessary to render an informed decision by the reviewing agency at a particular stage. In this manner, the town has determined that it is both inappropriate and unnecessary to require a full set of architectural or engineering drawings for review by the various review and decision-making boards unless the application is such that a specific level of detail is necessary (e.g., floodplain/stormwater variance). The Application Checklists located on the Town of Wake Forest website are intended to provide further guidance to applicants as to the necessary level of detail for certain permit/process types. Permits/processes for which additional detail is included in these Application Checklists are marked with an asterisk (*) in the table below.

Permit/ Process Type	Section	PUD Concept Plan (15.4.8)	Existing Conditions Map (15.4.1)	Sketch Plan (15.4.2)	Master Plan (15.4.3)	Construction Plans (15.4.4)	As-Built Drawings (15.4.5)	Final Plat (15.4.5)	Building Elevations (15.4.7)
Development Permit *	15.6.1			X*(a)*					
Temporary Use Permit	15.6.2			X*(a)*					
Certificate of Completion	15.6.3		See Administrator						
Modification of Setbacks	15.6.4			X					
Tree Clearing Permit *	15.7.1		X*(a)*			X			
Land Disturbance Permit*	15.7.2		X			X			
Floodplain Development Permit *	15.7.3		X*(a)*			X	X		
Stormwater Permit *	15.7.4 {}		X(a)			X	X		
Site Master Plan *	15.8.1		X		X				
Site Construction Plan *	15.8.2		X			X	X*(a)*		
Architectural Design Review *	15.8.3			X*(a)*					X
Subdivision Master Plan *	15.9.1		X		X				
Subdivision Construction Plan*	15.9.2		X			X	X*(a)*		
Final Plat*	15.9.3						X*(a)*	X	
Special Use Permit	15.10		X		X				
Designation of Historic Landmarks/Districts	15.11.1		X	X					
Certificate of Appropriateness (Minor Works)	15.11.2			X					X*(a)*
Certificate of Appropriateness (Major Works)	15.11.3			X					X *(a)*
Certificate of Appropriateness (Demolition of Historic Structures)	15.11.4		X	X	X (a)				

Permit/ Process Type	Section	PUD Concept Plan (15.4.8)	Existing Conditions Map (15.4.1)	Sketch Plan (15.4.2)	Master Plan (15.4.3)	Construction Plans (15.4.4)	As-Built Drawings (15.4.5)	Final Plat (15.4.5)	Building Elevations (15.4.7)
Appeal of Administrative Decision	15.12		See Administrator						
Variance	15.13		See Administrator						
Text Amendment	15.14		See Administrator						
Map Amendment (Rezoning)	15.14		See Administrator						
Comprehensive Plan Amendment	15.15		See Administrator						
Conditional Zoning	15.16		X	X*(a)*	X				
Planned Unit Development Rezoning	15.17	X	X				X	X	
Annexation and ETJ Expansion	15.18		See Administrator						
**Additional detail provided in the Application Checklists* *X - Required | X(a) - as needed*									

15.4.1. Existing Conditions Map

An existing conditions map is intended to identify existing developed conditions and natural features including, but not limited to, the following:

A. Existing Developed Conditions of Property

1. Rights of way
2. Existing structures with built year & historical significance;
3. Cemeteries;
4. Bridges or culverts;
5. Utilities (water & sewer, drainage, storm water, electrical, cable, fiber optics, etc.);
6. Driveways & curb cuts;
7. Sidewalks, surface parking & loading areas;
8. Public and private streets with pavement width;
9. Any known contaminated soils or hazardous materials;
10. Existing & proposed easements including but not limited to, electric, water, sewer, storm, drainage, private streets, gas, or other service related easements including location, width & purpose.

B. Existing Natural Features of Property

1. Forest stands or trees of a uniform size and species;
2. Specimen trees of varying sizes and species, particularly free standing or open-grown or field grown trees;

3. Previously documented rare or protected species' habitats.
4. Riparian & watershed boundaries/buffers, wetlands, watercourses with name and direction of flow;
5. State & federal reports regarding wetlands and stream buffer delineations;
6. Special flood hazard areas;
7. Wood line & vegetation type with location of all specimen trees;
8. Soils map;
9. Existing contour lines at a minimum of 2 foot contour intervals.

C. Identification of the above features on a site prior to the advanced preparation of development plans enables the reasonable and practical planned preservation of existing and environmentally sensitive areas. This requirement provides the town and the applicant the ability to evaluate the proposed development in order to preserve vegetation, to improve the appearance of the development proposed and to encourage the use of the existing forest and tree canopy, specimen trees, and significant vegetation to satisfy the requirements of this ordinance.

15.4.2. Sketch Plan

The Sketch Plan shall show in simple sketch form the shape and dimensions of the lot on which the proposed building or use is to be constructed or conducted; proposed layout of existing and proposed streets, existing or proposed lot(s) layout, building(s) location and size, nature of land use, parking areas and means of ingress/egress, environmental conditions (i.e. Special Flood Hazard, wetlands, etc.); civic spaces and other features in relation to existing conditions based upon the size of the tract proposed for development. Sketch Plans shall be reviewed as binding documents for Certificates of Unified Development Ordinance {} Completion (15.6.3), but shall be used for non-binding review for all other development application processes in which a Sketch Plan is required. See Sketch Plan Checklist for required submittal information.

15.4.3. Master Plan

The Master Plan is intended to provide a detailed two-dimensional drawing that illustrates all of the required site features and all related development calculations in sufficient detail to show compliance with this ordinance. Detailed engineering drawings such as subsurface utilities (e.g., water and sewer) and on-site stormwater facilities are not required for Master Plans, except that horizontal water and sewer locations shall be indicated as required by the City of Raleigh Public Utilities Department. Plans shall be prepared by a licensed professional. See Master Plan Checklist for required submittal information.

15.4.4. Construction Plans

Construction Plans shall constitute a full and complete set of engineered drawings necessary for final permitting and construction. Plans shall be prepared by a licensed professional. See construction Plan Checklist for required submittal information.

15.4.5. As-Built Drawings

The "as built" plans shall show the final design specifications for all public infrastructure. For stormwater infrastructure this shall include, but is not limited to, the as-built basin volumes, slopes, inverts and tops of stormwater pipes, manholes, catch basins, BMP's

installed, and a notarized operation and maintenance agreement for BMP's. The designer of the infrastructure shall certify, under seal, that the installed infrastructure is in substantial compliance with the approved plans and designs and with the requirements of this ordinance. A final inspection and approval by the Administrator shall occur before the release of any performance securities.

15.4.6. Final Plat

The final plat shall be prepared by a professional land surveyor, licensed to practice in the State of North Carolina and shall meet the requirements of NCGC 47-30. See Final Plat Checklist for required submittal information.

15.4.7. Building Elevations For Design Review

Scaled drawings of each elevation shall be submitted to verify compliance with this ordinance. These drawings shall be in color and accurately represent the building heights, floor levels, and building materials. In addition, the Administrator may require up to 3 drawings from different perspectives that will show how the building fits into the context of the block. See Architectural Review Checklist for required submittal information.

15.4.8. PUD Concept Plan

The PUD Concept Plan shall accompany a Planned Unit Development (PUD) (see Section 2.7) rezoning request. The application for the Planned Unit Development held and maintained by the Planning Department will contain a detailed checklist for the PUD Concept Plan. Generally, the concept plan shall include the following:

A. Planned Unit Development Intent and Compatibility Statement

A written statement must be submitted that includes a description of the relationship of the Planned Unit Development to the surrounding land uses and the uses within the development to each other, the compatibility of the request with the Town of Wake Forest Comprehensive Plan maps and objectives, and any other supporting information regarding the request. The statement shall demonstrate how the flexibility granted through the PUD will result in a higher quality development.

B. Detailed District Criteria

In accordance with UDO Section 2.7 and PUD application, each PUD Concept Plan shall specify development standards applicable to each permitted use in the PUD and contain the following:

1. Vicinity Map;
2. Perimeter Boundary & Topographic Survey;
3. Existing Conditions Map (see Section12.4.1.B for required components);
4. Land Use Map;
5. Vehicular & Pedestrian Circulation Plan;
6. Utility Access & Connection Plan;
7. Buffers, Open Space & Recreation Facilities Plan; and
8. A Table summarizing the sections of the UDO that will be varied in the PUD.

C. Traffic Impact Analysis (see Section 6.12)

A Traffic Impact Analysis (TIA) shall be required with all concept plans submittals to verify that there are adequate transportation facilities for the proposed development. This report must be submitted, reviewed, and approved prior to the project going to the Planning Board and the Board of Commissioners.

15.5. GENERAL REQUIREMENTS FOR QUASI-JUDICIAL EVIDENTIARY HEARINGS AND DECISIONS

A quasi-judicial decision is a process that involves the finding of facts regarding a specific application of an ordinance and the exercise of discretion when applying the standards of the ordinance. Quasi-judicial decisions include decisions involving variances, special use permits, and appeals of administrative determinations. As a result the following standard procedures shall be incorporated as appropriate.

15.5.1. Standards For Conduct of Quasi-Judicial Evidentiary Hearings

A. **Contact with Decision-Making Board Members:** Contact with any members of a decision-making board prior to the evidentiary public hearing by any individual regarding the matter is prohibited.

B. **Conflicts of Interest:** A member of the decision-making board shall not participate in or vote on a quasi-judicial matter in a manner that would violate affected persons' constitutional rights to an impartial decision maker. Impermissible conflicts include, but are not limited to, a member having a fixed opinion prior to hearing the matter that is not susceptible to change, a close familial, business, or other associational relationship with an affected person, or a financial interest in the outcome of the matter. If an objection is raised to a member's participation and that member does not recuse himself or herself, the remaining members shall by majority vote rule on the objection.

C. **Participants:** The applicant, the town, and any person who would have standing to appeal the decision under NCGS shall have a right to participate as a part at the evidentiary hearing. For appeals, the official who made the decision, or the person currently occupying that position if the decision-maker is no longer employed by the town, shall be present at the evidentiary hearing as a witness.

D. **All Participants to be Sworn In:** All participants in the evidentiary public hearing shall be duly sworn in prior to the submission of any testimony.

E. **Competent Evidence Required:** All decisions shall be based on competent evidence entered in as part of the record. The term "competent evidence," as used in this subsection, shall not preclude reliance by the decision-making board on evidence that would not be admissible under the rules of evidence as applied in the trial division of the General Court of Justice if (i) the evidence was admitted without objection, or (ii) the evidence appears to be sufficiently trustworthy and was admitted under such circumstances that it was reasonable for the decision-making board to rely upon it. The board chair shall rule on any objections made to the board regarding jurisdictional and evidentiary issues. The term "competent evidence," as used in this subsection, shall not be deemed to include the opinion testimony of lay witnesses as to any of the following:

1. The use of property in a particular way would affect the value of other property.
2. The increase in vehicular traffic resulting from a proposed development would pose a danger to the public safety.
3. Matters about which only expert testimony would generally be admissible under the rules of evidence.

F. **Cross-Examination Permitted:** The cross-examination of witnesses submitting testimony shall be permitted upon request.

15.5.2. Standards For Decisions

Each decision-making board under the provisions of this section shall ensure that the rights of petitioners have not been prejudiced because of the decision-making body's findings, inferences, or conclusions. In addition such decision shall not be:

A. In violation of constitutional provisions, including those protecting procedural due process rights.

B. In excess of the statutory authority conferred upon the town or the authority conferred upon the decision-making board by ordinance.

C. Inconsistent with applicable procedures specified by statute or ordinance.

D. Affected by other error of law.

E. Unsupported by substantial competent and material evidence in view of the entire record.

F. Arbitrary and capricious.

15.5.3. Record of Decision

A. The following shall become part of the official record of decision:

1. Documents and exhibits submitted to the decision-making board
2. Meeting minutes

B. **Transcript of Audio/Video of Meetings:** Any party may request, at their expense, a transcript of the proceedings from any recorded audio/video.

15.6. ADMINISTRATIVE PERMITS

15.6.1. Development Permit

A development permit indicates compliance with the provisions of the Unified Development Ordinance and shall be required for the construction or development of any new use within the land development jurisdiction of the Town of Wake Forest, and any other site improvement as indicated in the UDO. In addition to new uses, a development permit shall be required for expansions of existing uses, changes of use, any uses permitted with special conditions (Chapter 3) and any signage requiring a permit (Chapter 11).

A. **Process Type:** Administrative

B. **Pre-Application Procedure:** No meeting is required but applicants are encouraged to call or visit the Administrator prior to requesting a Development Permit to determine what information is required for the application.

C. **Required Application Information:** Sketch Plan (15.4.2) and any other relevant information to show compliance (may be waived by Administrator as appropriate)

D. **Determination of Compliance:** Once an application containing all needed elements is submitted, the Administrator shall review the application and approve or deny it based on compliance with the land development standards contained in this ordinance. All decisions shall be in writing and delivered via electronic mail, personal delivery, or first class mail to the property owner and parking seeking determination, if different from the owner.

E. **Public Notification:** N/A

F. **Appeals:** Appeals of the decisions of the Administrator shall be heard by the Board of Adjustment in accordance with Section 15.12 within 30 days after receipt of written notice of decision.

G. **Permit Validity:** Upon the approval of the Development Permit, the applicant shall have one year to obtain a building permit or otherwise begin the permitted use. Failure to secure building permits for the permitted work within this time shall render the compliance void. Upon issuance of a building permit, the Development Permit shall remain valid as long as a valid building permit exists for the project. Any change

to the approved plans that has not been authorized by the Administrator shall invalidate the Development Permit and any subsequent building permits.

H. **Permit Extension:** The Administrator may grant 2 extensions of this time period of up to 6 months upon submittal by the applicant of sufficient justification for the extension. Sufficient justification may include, but is not limited to, delays in other outside agency permits, financing institution delays, or other similar reasons beyond the control of the applicant.

I. **Limitation on Administrative Discretion:** The Administrator has no discretion to modify any requirements found in Chapter 3.

15.6.2. Temporary Use Permit

A Temporary Use Permit is required for uses permitted in accordance with Section 4.7 prior to the commencement of any use or activity.

A. **Process Types:** Administrative

B. **Pre-Application Procedure:** No meeting is required but applicants are encouraged to call or visit the Administrator prior to requesting a Temporary Use Permit to determine what information is required for the application.

C. **Required Application Information:** Sketch Plan (15.4.2) and any other relevant information to show compliance (may be waived by Administrator as appropriate)

D. **Determination of Compliance:** Once an application containing all needed elements is submitted, the Administrator shall review the application and approve it, approve it with conditions, or deny it based on compliance with the land development standards contained in this ordinance. All decisions shall be in writing and delivered via electronic mail, personal delivery, or first class mail to the property owner and party seeking determination, if different from the owner.

E. **Public Notification:** N/A

F. **Appeals:** Appeals of the decisions of the Administrator shall be heard by the Board of Adjustment in accordance with Section 15.12 within 30 days after receipt of written notice of decision.

G. **Permit Validity:** See Section 4.7

H. **Permit Extension:** See Section 4.7

15.6.3. Certificate of Completion

Issuance of a certificate of completion shall be required prior to the occupancy or use of any new construction and re-occupancy or re-use of any renovation/rehabilitation in the Town of Wake Forest. Certificates of completion ensure that a completed development project has complied with all the applicable requirements of this ordinance and all other applicable federal, state and local regulations. Certificates of completion must be signed by the Administrator to certify compliance with applicable regulations.

A. **Process Type:** Administrative

B. **Pre-Application Procedure:** Not required

C. **Required Application Information:** None

D. **Determination of Compliance:** Upon receipt of the request for a certificate of completion, the Administrator shall inspect the project site for compliance with the approved site plan or subdivision plan and the applicable standards of this ordinance. The applicant shall be notified of any deficiencies in the building(s) or site that prevents the issuance of the certificate of completion or the certificate shall be issued. All decisions shall be in writing and delivered via electronic mail, personal delivery, or

first class mail to the property owner and party seeking determination, if different from the owner.

E. **Public Notification:** N/A

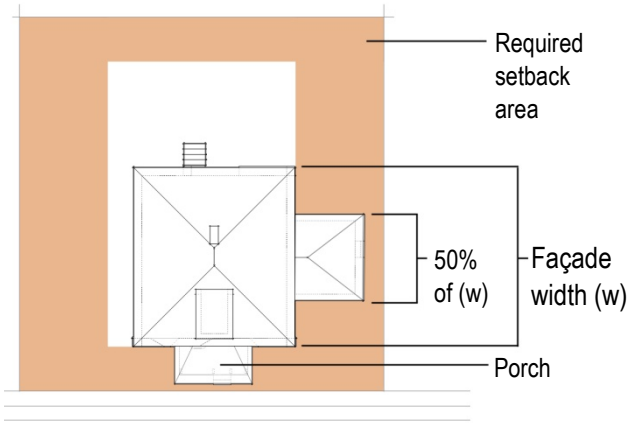
F. **Appeals:** Appeals of the decisions of the Administrator shall be heard by the Board of Adjustment in accordance with Section 15.12 within 30 days after receipt of written notice of decision.

G. **Permit Validity:** N/A

H. **Permit Extension:** N/A

15.6.4. Administrative Modification of Setbacks

In keeping with the purpose of these regulations to accomplish coordinated, balanced, and harmonious development in a manner which will best promote the health, safety, and general welfare while avoiding undue and unnecessary hardships, on approval by the Town Manager, the Administrator is authorized to approve certain requests for deviation from dimensional standards.



A. **Process Types:** Administrative

B. **Pre-Application Procedure:** Not required

C. **Required Application Information:** Sketch Plan (15.4.2) and any other relevant information to demonstrate undue and unnecessary hardship.

D. **Conditions for Modification of Setbacks:** Requests for deviation from required setbacks set forth in this ordinance by up to 10% of the required setbacks or 24 inches, whichever is greater, may be considered upon determination that one or more of the following conditions exists:

1. There are site or structural conditions that preclude strict adherence to the setback requirements, such as, but not limited to: the lot does not meet the dimensional standards established for the zoning district in which it is located; the lot has topographic limitations that require placement of the structure into the required setback area; or the structure is physically in line with an existing, legally established wall or walls of a principal structure already within the minimum setback area.
2. The part of the proposed structure that would encroach into the minimum setback area is less than 50% of the width of the affected building facade(s), provided the part of the structure that would encroach into a front setback shall either be open (such as a porch or screen room) or not subject to occupancy (such as a chimney).
3. The part of the proposed structure that encroaches into the minimum setback area is necessitated by a life-safety code, flood hazard reduction, Americans with Disabilities Act standard, or other public safety code requirements.
4. The proposed structure will allow the preservation of significant existing vegetation.
5. A good faith error was made in the location of a building foundation not exceeding 1 foot due to either field construction error or survey oversight.

E. **All Decisions to be in Writing:** Prior to rendering a decision, the Administrator shall notify the Town Manager in writing of any minor deviation for approval.

F. **Administrative Authority is Permissive Only:** The authority given to the Administrator to grant such modification shall be construed to be permissive and not mandatory and the Administrator may decline to make such modification. In the event this occurs, the applicant shall have the right to submit an application to the Board of Adjustment to grant a variance to these requirements in accordance with Section 15.13. Nothing in this section shall be construed as limiting the Administrator's duties and rights under this chapter, or an applicant's right to appeal the decision of the Administrator to the Board of Adjustment.

G. **Public Notification:** N/A

H. **Appeals:** Appeals of the decisions of the Administrator shall be heard by the Board of Adjustment in accordance with Section 15.12.

I. **Permit Validity:** N/A

J. **Permit Extension:** N/A

15.7. ENVIRONMENTAL PROTECTION PERMITS

15.7.1. Tree Clearing Permit

Pursuant to NCGS, prior to the commencement of any vegetation clearing or removal on any undeveloped property, the owner (or authorized agent) of such property must obtain a Tree Clearing Permit or demonstrate exemption from the requirements of this section as provided for in Section 15.7.1.A, below. For the purposes of the section, “undeveloped properties” shall include any property within the town’s jurisdiction that is not subject to an approved site and/or subdivision plan.

A. **Exemptions:** A Tree Clearing Permit shall not be required for the activities listed below.

1. Normal forestry activities taking place on property that is taxed under the present-use value standard or conducted pursuant to a forestry management plan prepared or approved by a forester registered pursuant to Chapter 89B of the North Carolina General Statutes, and provided such activities are accomplished in compliance with this ordinance.
2. Properties with a town-approved site and/or subdivision plan, provided such plan has not expired and that any clearing or vegetation removal is done in strict accordance with the approved site and/or subdivision plan.
3. The removal of vegetation by public or private agencies within the lines of any public street rights-of-way, utility easements, or other town property, as may be necessary to ensure public safety, to obtain clear visibility at driveways or intersections, to perform authorized field survey work, or to preserve or enhance the symmetry and beauty of such town property.
4. The town-initiated or approved removal of any vegetation which is in an unsafe condition, constitutes a nuisance or noxious weed, or which by its nature is injurious to sanitary sewers, electrical power lines, gas lines, water lines, stream or conveyance channels, or other public improvements, or vegetation which is infected with any injurious fungus, insect, or other pest.
5. The removal of vegetation on a lot of record, less than 5 acres in size and zoned and/or used for residential purposes, provided such vegetation is not a portion of a required streetyard or other required riparian or landscaping buffer.

B. **Process Type:** Administrative

C. **Permit Required Before Any Land Disturbing Activity:** No such land-disturbing activity shall take place until plans for vegetation clearing activity have been reviewed and approved in accordance with the procedures set forth below.

D. **Pre-Application Procedure:** Applicants are encouraged to meet with the Administrator prior to submitting an application for a Tree Clearing Permit. The purpose of this meeting is to discuss the project, the proposed design strategies, and to answer questions of the applicant regarding the application and schedules for review.

E. **Required Application Information:** Existing Conditions Map (15.4.1), Sketch Plan (15.4.2) (may be waived by Administrator as appropriate) & Construction Plans (15.4.4) (may be waived by Administrator as appropriate).

F. **Determination of Compliance:** Following submittal of the application the information shall be reviewed by the Administrator for compliance with the requirements of this ordinance. Provided the application is complete, the application shall be reviewed and acted upon by the staff and notice given the applicant within 30 days of receipt of the application. All decisions shall be in writing and delivered via electronic mail, personal delivery, or first class mail to the property owner and party seeking determination, if different form the owner.

G. **Public Notification:** N/A

H. **Appeals:** Appeals of the decision of the Administrator shall be heard by the Board of Adjustment in accordance with Section 15.12 within 30 days after receipt of written notice of disapproval or conditional approval that is unsatisfactory to the applicant.

I. **Permit Validity:** An approved Tree Clearing Permit shall be valid for a period of not more than one year.

J. **Permit Extension:** Renewal of an expired Tree Clearing Permit shall require the same application procedure as the initial permit. No further development activity is to be performed until the new permit is issued. Any significant changes to the plan must be re-submitted and re-reviewed.

15.7.2. Land Disturbance Permit (Erosion and Sedimentation Control)

A Land Disturbance Permit is required to assure that land-disturbing activity undertaken in the Town of Wake Forest does not result in accelerated erosion and sedimentation. No land-disturbing activity shall take place until plans for controlling erosion associated with the activity have been reviewed and approved in accordance with the procedures set forth below.

A. **Process Type:** Administrative

B. **Pre-Application Procedure:** Prior to applying for a land disturbance permit and submitting plans, the applicant is required to meet with the Administrator. The purpose of this meeting is to discuss the project, the proposed land development strategies, and to answer questions of the applicant regarding the application and schedules for review.

C. **Required Application Information:** Existing Conditions Map (15.4.1) & Construction Plans (15.4.4).

D. **Determination of Compliance:** Following submittal of a soil erosion and sedimentation control plan and accompanying data, the application shall be reviewed by the Town of Wake Forest Department of Engineering for compliance with the requirements of this ordinance. Provided the plan is complete, applications shall be reviewed and acted upon by the staff and notice given the applicant within 30 days of receipt of the application. Any plan submitted for a land-disturbing activity for which the North Carolina Environmental Policy Act requires an environmental document must be

deemed incomplete until a complete environmental document is available for review. The Administrator must promptly notify the person submitting the plan that the 30 day time limit for review of the plan will not begin until a complete environmental document is available for review. Denial of the application must specifically state in writing the reasons for denial. Subsequent plan revisions shall be reviewed and acted upon by the staff and notice given the applicant within 15 days of receipt of the revision. If an application has been disapproved, the applicant has 12 months to submit revised plans addressing the reasons for disapproval or the plan is deemed null and void. All decisions shall be in writing and delivered via electronic mail, personal delivery, personal delivery, or first class mail to the property owner and party seeking determination, if different from the owner.

E. **Other Disapprovals:** The Town shall disapprove erosion and sedimentation control plans (part of construction plans) if implementation of the plan would result in a violation of the rules adopted by the Environmental Management Commission (State) to protect riparian buffers along surface waters. The Town may disapprove the plan upon finding that an applicant or a parent, subsidiary, or other affiliate of the applicant:

1. Is conducting or has conducted land-disturbing activity without an approved plan, or has received a notice of violation of a plan previously approved by the Town pursuant to this Ordinance and has not complied with the notice within the time specified in the notice.
2. Has failed to pay a civil penalty assessed pursuant to this Ordinance by the time the payment is due.
3. Has been convicted of a misdemeanor pursuant to NCGS 113A-64(b) or any provision outlined in this Ordinance pursuant to this article.

F. **Public Notification**: N/A

G. **Appeals**: Appeals of the decision of the Administrator shall be heard by the Board of Adjustment in accordance with Section 15.12 within 15 days after receipt of written notice of disapproval or conditional approval that is unsatisfactory to the applicant. Appeals of the decision of the Board of Adjustment may be taken to the North Carolina Sedimentation Control Commission as provided in NCGS 113A-61(c).

H. **Permit Validity**: When work under a land disturbance permit is not completed within 2 years following the date of issuance of the land disturbance permit, the land disturbance permit shall be deemed expired.

I. **Permit Extension**: Permits may be renewed in one year increments until the project is complete. The appropriate renewal fees shall apply. Any significant changes to the plan must be re-submitted and re-reviewed.

15.7.3. Floodplain Development Permits

No approval shall be granted for construction in an area designated as a Special Flood Hazard Area by the flood insurance rate maps, as provided by the Federal Emergency Management Agency without the issuance of a floodplain development permit. Because Special Flood Hazard Areas are determined by FEMA and State requirements, if activities are permitted in Special Flood Hazard Areas at the State or Federal level, then they are exempt from the requirements of this section.

A. **Process Types:** Administrative

B. **Permit Required Before Any Land Disturbing Activity:** No such land-disturbing activity shall take place in areas designated as Special Flood Hazard areas until plans

associated with the activity have been reviewed and approved in accordance with the procedures set forth below.

C. **Pre-Application Procedure:** Applicants are encouraged to meet with the Administrator prior to submitting an application for development in the designated flood hazard area. The purpose of this meeting is to discuss the project, the proposed design strategies, and to answer questions of the applicant regarding the application and schedules for review.

D. **Required Application Information:** Existing Conditions Map (15.4.1) (may be waived by Administrator as appropriate), Construction Plans (15.4.4), & As-Built Drawings – upon completion (15.4.5).

E. **Additional Information Required for Floodplain Development Permits:** The following specific items/information shall be presented to the Administrator in an application for a floodplain development permit:

1. **Plan Information Requirements**

   a. A plot plan drawn to scale which shall include, but shall not be limited to, the following specific details of the proposed floodplain development:

      i. The nature, location, dimensions, and elevations of the area of development/disturbance; existing and proposed structures, utility systems, grading/pavement areas, fill materials, storage areas, drainage facilities, and other development;

      ii. The boundary of the Special Flood Hazard Area or Future Conditions Flood Hazard Area as delineated on the FIRM or other flood map as determined in Section 12.4.1.C, or a statement that the entire lot is within the Special Flood Hazard Area or Future Conditions Flood Hazard Area;

      iii. Flood zone(s) designation of the proposed development area as determined on the FIRM or other flood map as determined in Section 12.4.1.C;

      iv. The boundary of the floodway(s) or non-encroachment area(s) as determined in Section 12.4.1.C;

      v. The Base Flood Elevation (BFE) or Future Conditions Flood Elevation where provided as set forth in Section 12.4.1.C;

      vi. The old and new location of any watercourse that will be altered or relocated as a result of proposed development;

      vii. Certification of the plot plan by a registered land surveyor or professional engineer.

   b. Proposed elevation and method thereof, of all development within a special Flood Hazard Area or Future Conditions Flood Hazard Area including but not limited to:

      i. Elevation in relation to mean sea level of the proposed reference level (including basement) of all structures;

      ii. Elevation in relation to mean sea level to which any non-residential structure in Zone AE, A or X (Future) will be flood-proofed; and

      iii. Elevation in relation to mean sea level to which any proposed utility systems will be elevated or floodproofed;

c. If floodproofing, a Floodproofing Certificate (FEMA Form 81-65) with supporting data and an operational plan that includes, but is not limited to, installation, exercise, and maintenance of floodproofing measures.

d. A foundation plan, drawn to scale, which shall include details of the proposed foundation system to ensure all provisions of this ordinance are met. These details include but are not limited to:

i. The proposed method of elevation, if applicable (i.e., fill, solid foundation perimeter wall, solid backfilled foundation, open foundation on columns/posts/piers/piles/shear walls);

ii. Openings to facilitate equalization of hydrostatic flood forces on walls, when solid foundation perimeter walls are used in Zones A, AE and X (future);

iii. Usage details of any enclosed areas below the regulatory flood protection elevation.

iv. Plans and/or details for the protection of public utilities and facilities such as sewer, gas, electrical, and water systems to be located and constructed to minimize flood damage.

v. Copies of all other Local, State and Federal permits required prior to floodplain development permit issuance (Wetlands, Endangered Species, Erosion and Sedimentation Control, Riparian Buffers, Mining, etc.).

vi. Documentation for placement of Recreational Vehicles and/or Temporary Structures, when applicable.

vii. A description of proposed watercourse alteration or relocation, when applicable, including an engineering report on the effects of the proposed project on the flood-carrying capacity of the watercourse and the effects to properties located both upstream and downstream; and a map (if not shown on plot plan) showing the location of the proposed watercourse alteration or relocation.

2. **Certification Requirements**

a. **Elevation Certificates**

i. An Elevation Certificate (FEMA Form 81-31) is required prior to the actual start of any new construction. It shall be the duty of the permit holder to submit to the floodplain administrator a certification of the elevation of the reference level, in relation to mean sea level. The floodplain administrator shall review the certificate data submitted. Deficiencies detected by such review shall be corrected by the permit holder prior to the beginning of construction. Failure to submit the certification or failure to make required corrections shall be cause to deny a floodplain development permit.

ii. All residential dwellings to be constructed in or within 10 feet (linear) of the Special Flood Hazard Area and Future Conditions Flood Hazard Areas will be required to have the footing pinned by a professional land surveyor prior to construction. In addition, a survey will be required at the foundation and flooring system

inspection showing the elevations at the corners of the dwelling unit.

iii. A final as-built Elevation Certificate (FEMA Form 81-31) along with a final registered survey of the property is required after construction is completed and prior to Certificate of Completion/Occupancy issuance. It shall be the duty of the permit holder to submit to the floodplain administrator a certification of final as-built construction of the elevation of the reference level and all attendant utilities. The floodplain administrator shall review the certificate data submitted. Deficiencies detected by such review shall be corrected by the permit holder immediately and prior to Certificate of Completion/ Occupancy issuance. In some instances, another certification may be required to certify corrected as-built construction. Failure to submit the certification or failure to make required corrections shall be cause to withhold the issuance of a Certificate of Completion/Occupancy.

b. **Floodproofing Certificate:** If non-residential floodproofing is used to meet the regulatory flood protection elevation requirements, a Floodproofing Certificate (FEMA Form 81-65), with supporting data and an operational plan, is required prior to the actual start of any new construction. It shall be the duty of the permit holder to submit to the floodplain administrator a certification of the floodproofed design elevation of the reference level and all attendant utilities, in relation to mean sea level. Floodproofing certification shall be prepared by or under the direct supervision of a professional engineer or architect and certified by same. The floodplain administrator shall review the certificate data and plan. Deficiencies detected by such review shall be corrected by the applicant prior to permit approval. Failure to submit the certification or failure to make required corrections shall be cause to deny a floodplain development permit. Failure to construct in accordance with the certified design shall be cause to withhold the issuance of a Certificate of Completion/Occupancy.

i. If a manufactured home is placed within Zone A, AE or X (Future) and the elevation of the chassis is more than 36 inches in height above grade, an engineered foundation certification is required per Section 12.4.2.B.3.

ii. If a watercourse is to be altered or relocated, a description of the extent of watercourse alteration or relocation; a professional engineer's certified report on the effects of the proposed project on the flood-carrying capacity of the watercourse and the effects to properties located both upstream and downstream; and a map showing the location of the proposed watercourse alteration or relocation shall all be submitted by the permit applicant prior to issuance of a floodplain development permit.

3. **Certification Exemptions:** The following structures, if located within Zone A, AE or X (Future), are exempt from the elevation/floodproofing certification requirements specified above:

a. Recreational Vehicles meeting requirements of Section 12.4.2.B.5; and

b. Accessory Structures less than 150 square feet meeting requirements of Section 12.4.2.B.6.

F. **Determination of Compliance:** Following submittal of the application and accompanying data, the information shall be reviewed by the Administrator for compliance with the requirements of this ordinance. Provided the application is complete, applications shall be reviewed and acted upon by the staff and notice given the applicant within 30 days of receipt of the application. All decisions shall be in writing and delivered via electronic mail, personal delivery, or first class mail to the property owner and party seeking determination, if different from the owner. An approved Floodplain/Watershed Development Permit shall include the following information:

1. A description of the development to be permitted under the floodplain development permit.
2. The Special Flood Hazard Area or Future Conditions Flood Hazard Area determination for the proposed development per available data specified in Section 12.4.1.C.
3. The regulatory flood protection elevation required for the reference level and all attendant utilities.
4. The regulatory flood protection elevation required for the protection of all public utilities.
5. All certification submittal requirements with timelines.
6. A statement that no fill material or other development shall encroach into the floodway or non-encroachment area of any watercourse, as applicable.
7. The flood openings requirements, if in Zones A, AE or X (Future)

G. **Public Notification:** N/A (Except as required by State or Federal Agencies)

H. **Appeals:** Appeals of the decisions of the Administrator shall be heard by the Board of Adjustment in accordance with Section 15.12 within 30 days after receipt of written notice of decision.

I. **Permit Validity:** Floodplain development permits shall be valid for one year. Failure to initiate construction, or otherwise begin the permitted use, within this time period shall render the permit void.

J. **Permit Extension:** Renewal of an expired floodplain development permit shall require the same application procedure as the initial permit. No further development activity is to be performed until the new permit is issued.

15.8. SITE PLANS/DESIGN REVIEW

15.8.1. Site Master Plan

A. **Applicability:** The Site Master Plan process shall apply to development activities meeting the development definition which are not otherwise approved by other development permits and approvals.

B. **Process Type:** Administrative.

C. **Pre-Application Procedure:** It is required that every applicant for a Site Master Plan permit meet with the Administrator in a conference prior to the submittal of an application. The purpose of this conference is to provide clarification and assistance in the preparation and submission of plans for approval. The applicant shall provide a Sketch Plan (15.4.2) to the Administrator prior to or at the pre-application conference. The provisions of a sketch plan will allow the Administrator an opportunity to review the proposal before the applicant expends funds on the preparation of a detailed Site Master Plan.

D. **Required Application Information:** See Site Master Plan Checklist.

E. **Determination of Compliance:** Once an application is deemed complete by the Administrator, the Administrator and Technical Review Committee shall review the application and approve, deny, or approve with conditions the Site Plan based on compliance with the standards contained in this ordinance. All decisions shall be in writing and delivered via electronic mail, personal delivery, or first class mail to the property owner and party seeking determination, if different from the owner. Following an approval or approval with conditions, the applicant shall be directed to proceed to the preparation of a Site Construction Plan (15.8.2). If the Administrator disapproves or approves conditionally the plan, the reasons for such action shall be stated in writing by the Administrator, and the applicant may make changes and submit a revised plan for consideration in accordance with the procedures set forth in this section.

F. **Public Notification:** None required.

G. **Appeals:** Appeals of the decisions of the Administrator or TRC shall be heard by the Board of Adjustment in accordance with Section 15.12 within 30 days after receipt of written notice of decision.

H. **Permit Validity:** Approval of a Site Master Plan shall be valid for 2 years from the date of approval. A Site Construction Plan shall be presented for approval prior to the end of this 2 year period.

I. **Permit Extension:** The Administrator may grant a single extension of this time period of up to one year upon submittal by the applicant of sufficient justification for the extension. Sufficient justification may include, but is not limited to, delays in other outside agency permits, financing institution delays, or other similar reasons beyond the control of the applicant. If an extension is denied, or a Site Construction Plan is not presented for approval within a granted extension period, the applicant may reapply for a Site Master Plan using the same process as if the application was being considered for the first time.

15.8.2. Site Construction Plan

A. **Process Type:** Administrative

B. **Pre-Application Procedure:** No meeting is required but applicants are encouraged to call or visit the Administrator to determine what information is required for the application.

C. **Required Application Information:** See Construction Plan Checklist.

D. **Determination of Compliance:** The Site Construction Plan shall be reviewed by the Technical Review Committee for compliance with the requirements of this chapter and for conformity with the approved Site Master Plan, if applicable. Provided the application is complete, applications shall be reviewed by the committee and written review comments will be given to the applicant within 45 days of receipt of the Site Construction Plan.

E. **Public Notification:** N/A

F. **Appeals:** Appeals of decisions of a member of the Technical Review Committee shall be heard by the Board of Adjustment in accordance with Section 15.12. An appeal must be made in writing by the applicant within 30 days of the receipt of the committee member's comments.

G. **Permit Required Before Any Land Disturbing Activity:** No such land-disturbing activity shall take place until a Site Construction Plan has been approved, unless otherwise approved by the Administrator.

H. **Permit Validity:** Approval of a Site Construction Plan shall be valid for 2 years from the date of approval. A Final Plat (See Section 15.9.4) {} shall be recorded prior to the end of this 2 year period.

I. **Permit Extension:** The Administrator may grant a single extension of this time period of up to one year upon submittal by the applicant of sufficient justification for the extension. Sufficient justification may include, but is not limited to, delays in other outside agency permits, financing institution delays, or other similar reasons beyond the control of the applicant.

15.8.3. Architectural Design Review

A. **Applicability:** Any application for new buildings and structures or changes to existing buildings and structures, other than single family detached, duplex or townhomes uses, will be reviewed by the Administrator for architectural design compliance with the standards of this ordinance.

B. **Process Types:** Administrative

C. **Pre-Application Procedure:** No meeting is required but applicants are encouraged to call or visit the Administrator to determine what information is required for the application.

D. **Required Application Information:** Sketch Plan (15.4.2) (may be waived by Administrator as appropriate) & Building Elevations for Design Review (15.4.7).

E. **Determination of Compliance:** Once an application containing all needed elements is submitted, the Administrator shall review the application and approve or deny it based on compliance with the land development standards contained in this ordinance. All decisions shall be in writing and delivered via electronic mail, personal delivery, or first class mail to the property owner and party seeking determination, if different from the owner.

F. **Public Notification:** N/A

G. **Appeals:** Appeals of the decisions of the Administrator shall be heard by the Board of Adjustment in accordance with the procedures set out for Appeals in Section 15.12 within 30 days after receipt of written notice of decision.

H. **Permit Validity:** Upon the approval of the application, the applicant shall have one year to obtain a building permit. Failure to secure building permits within this time shall render the compliance void. Any change to the approved plans that has not been authorized by the Administrator shall invalidate the approval and any subsequent building permits.

I. **Permit Extension:** N/A.

15.9. SUBDIVISIONS

15.9.1. Subdivision Master Plan

A. **Applicability:** The subdivision review process is required for all divisions of land, except those subdivisions exempt by state statute.

B. **Process Types:** Administrative

C. **Pre-Application Procedure:** It is required that every applicant for a Subdivision meet with the Administrator prior to the submittal of an application. The purpose of this meeting is to provide clarification and assistance in the preparation and submission of plats for approval. The applicant shall provide a Sketch Plan (15.4.2) to the Administrator prior to or at the pre-application meeting. The provision of a sketch plan will allow the Administrator an opportunity to review the proposal before the applicant expends funds on the preparation of a detailed Subdivision Plan.

D. **Required Application Information:** See Subdivision Checklist.

E. **Determination of Compliance:** Once an application is submitted and deemed complete, the Administrator shall review the application and approve or deny it based on compliance with the land development standards contained in this ordinance within 30 working days of its submittal. All decisions shall be in writing and delivered via electronic mail, personal delivery, or first class mail to the property owner and party seeking determination, if different from the owner.

F. **Public Notification:** N/A

G. **Appeals:** Appeals of the decisions of the Administrator shall be heard by the Board of Adjustment in accordance with Section 15.12. An appeal must be made in writing by the applicant within 30 days of the receipt of the Administrator's decision.

H. **Permit Validity:** Approval of a Subdivision Master Plan shall be valid for 2 years from the date of approval. If a Subdivision Construction Plan approval has not been obtained prior to the end of this 2 year period, the Subdivision Master Plan approval shall become void unless a Subdivision Construction Plan is not required. Subdivisions may be phased according to a schedule established by the applicant. If the approved Subdivision Master Plan provides for multiple phases within the subdivision, a Subdivision Construction Plan approval for any one phase shall extend the Subdivision Master Plan approval for all other phases for a period of 2 years from the date of the Subdivision Construction Plan approval for that phase.

I. **Permit Extension:** The Administrator may grant a single extension of this time period of up to one year upon submittal by the applicant of sufficient justification for the extension. Sufficient justification may include, but is not limited to, delays in other outside agency permits, financing institution delays, or other similar reasons beyond the control of the applicant. If an extension is denied, or a Site Construction Plan is not presented for approval within a granted extension period, the application may reapply for a Site Master Plan using the same process as if the application was being considered for the first time.

15.9.2. Subdivision Construction Plan

A. **Process Type:** Administrative

B. **Pre-Application Procedure:** No meeting is required but applicants are encouraged to call or visit the Administrator to determine what information is required for the application.

C. **Required Application Information:** See Subdivision Construction Plan Checklist

D. **Determination of Compliance:** The Subdivision Construction Plan shall be reviewed by the Technical Review Committee for compliance with the requirements of this chapter and for conformity with the approved Subdivision Master Plan. Provided the application is complete, applications shall be reviewed and acted upon by the committee and notice given the applicant within 30 days of receipt of the subdivision construction plan. All decisions shall be in writing and delivered via electronic mail, personal delivery, or first class mail to the property owner and party seeking determination, if different from the owner.

E. **Public Notification:** N/A

F. **Appeals:** Appeals of a decision of a member of the Technical Review Committee shall be heard by the Board of Adjustment in accordance with Section 15.12. An appeal must be made in writing by the applicant within 30 days of the receipt of the committee's decision.

G. **Phasing:** Subdivision Construction Plans for phased subdivisions shall be reviewed and recorded individually in accordance with the schedule presented by the applicant during the Subdivision Master Plan approval.

H. **Permit Required Before Any Land Disturbing Activity:** No such land-disturbing activity shall take place until a Subdivision Construction Plan has been approved, unless otherwise approved by the Administrator.

I. **Permit Validity:** Approval of a Subdivision Construction Plan shall be valid for 2 years from the date of approval. A Final Plat shall be recorded prior to the end of this 2-year period.

J. **Permit Extension:** The Administrator may grant a single extension of this time period of up to one year upon submittal by the applicant of sufficient justification for the extension. Sufficient justification may include, but is not limited to, delays in other outside agency permits, financing institution delays, or other similar reasons beyond the control of the applicant.

15.9.3. Final Plat

A. **Process Types:** Administrative

B. **Improvements to Be Installed or Guaranteed:** All required infrastructure improvements shall be either installed or financially guaranteed in accordance with Section 6.13 for applicable subdivision and site master plans.

C. **As-Builts Required:** Upon completion of a subdivision or site master plan project, and before a Final Plat shall be approved (unless financially guaranteed), the applicant shall certify that the completed project is in substantial accordance with the approved plans and designs, and shall submit actual "as built" plans (15.4.5) for all public infrastructure after final construction is completed.

D. **Required Application Information:** See Final Plat Checklist.

E. **Determination of Compliance:** The Final Plat shall be reviewed by the Administrator for compliance with the requirements of this chapter and, in the case of major subdivisions, for conformity with the approved Subdivision Construction Plan. Provided the application is complete, applications shall be reviewed and acted upon by the committee and notice given to the applicant within 30 days of receipt of the Final Plat. If the Administrator has not completed the review in this time period, the applicant may seek final approval from the Board of Commissioners at their next meeting. All decisions shall be in writing and delivered via electronic mail, personal delivery, or first class mail to the property owner and party seeking determination, if different from the owner.

F. **Public Notification:** N/A

G. **Appeals:** Appeals of the decisions of the Administrator shall be heard by the Board of Adjustment in accordance with Section 15.12. An appeal must be made in writing by the applicant within 30 days of the receipt of the Administrator's decision.

H. **Effect of Approval:** The approval of a Final Plat does not constitute acceptance for maintenance or other purposes of improvements in rights-of-way, such as utility lines, street paving, drainage facilities or sidewalks. Such improvements, when located within the corporate limits of the Town of Wake Forest, may be accepted only by action of the town following inspection and approval. Land designated as public open space or a park on a plat shall be considered to be offered for dedication, but not accepted until the Board of Commissioners has by expressed action done so.

I. **Phasing:** Final plats for phased subdivisions shall be recorded in accordance with the schedule presented by the applicant during the Subdivision Construction Plan approval.

J. **Permit Validity:** Final plats that have been granted approval must be recorded within 30 days following approval or the approval becomes invalid. No lots in a subdivision shall be sold prior to approval by the town and recording of the Final Plat for the subdivision.

K. **Permit Extension:** None.

15.10. SPECIAL USE PERMITS (SUP)

Special uses are land uses that are generally compatible with the land uses permitted by right in a zoning district, but which require individual review of their location, design, and configuration so as to evaluate the potential for adverse impacts on adjacent property and uses. Special uses ensure the appropriateness of the use at a particular location within a given zoning district. Applications requiring a Special Use Permit are noted in Section 2.3 & Chapter 3.

15.10.1. Application Procedures

A. **Process Type:** Quasi-Judicial (See also 15.5)

B. **Pre-Application Meeting:** Every applicant for a Special Use Permit is required to meet with the Administrator in a pre-application conference prior to the submittal of a formal application. The purposes of this conference are to provide additional information regarding the review process and assistance in the preparation of the application.

C. **Required Application Information:** An application for a Special Use Permit may be filed by the owner of the property or by an agent specifically authorized by the owner to file such application. Each application for a Special Use Permit shall contain, at a minimum, an Existing Conditions Map (15.4.1) (may be waived by Administrator as appropriate) and Master Plan (15.4.3). Other information necessary to show that the use or structure complies with the standards set forth in this ordinance shall also be provided.

D. **Determination of Compliance:** The Administrator shall review the application to ensure that it is complete, prepare a report and recommendation on the application, and schedule the matter for an evidentiary public hearing before the Board of Adjustment.

E. **Public Notification:** Level 1, 2, 4 & 5 required.

15.10.2. Consideration By Board of Commissioners

A. **Public Hearing and Consideration by the Board of Commissioners:** The Board of Commissioners shall conduct an evidentiary public hearing on the matter. Upon reviewing all pertinent information, the Board of Commissioners may approve, deny or approve with conditions the Special Use Permit.

B. **Review Period:** The Board of Commissioners shall take action (approve, deny, or approve with conditions) within 65 days of the evidentiary public hearing on the matter. Should the Board of Commissioners fail to act on the Special Use Permit application within the prescribed period, the application shall be considered approved.

C. **Findings of Fact:** In addition to determining that the application meets all other requirements of this ordinance (no variances are permitted) the Board of Commissioners must find the following in order to grant approval of a Special Use Permit:

1. The proposed special use conforms to the character of the neighborhood, considering the location, type and height of buildings or structures and the type and extent of landscaping on the site.

2. The proposed use will not cause undue traffic congestion or create a traffic hazard.
3. Adequate utilities (water, sewer, drainage, electric, etc.) are available for the proposed use.
4. The proposed use shall not be noxious or offensive by reason of vibration, noise, odor, dust, smoke or gas.
5. The establishment of the proposed use shall not impede the orderly development and improvement of surrounding property.
6. The establishment, maintenance or operation of the proposed use shall not be detrimental to or endanger the public health, safety or general welfare.
7. The proposed use will not substantially injure the value of adjoining or abutting property.
8. The proposed use is consistent with the officially adopted plans and policies of the town.

D. Additional Standards for Special Uses in Floodplain Hazard Areas: Applications for Special Use Permits in the Special Flood Hazard Areas and Future Conditions Flood Hazard Areas shall be subject to the following additional standards of review:

1. The Board of Commissioners shall determine the specific flood or erosion hazard of the site and shall evaluate the suitability of the proposed use in relation to the flood hazard.
2. In passing upon such applications, the Board of Commissioners shall consider all technical evaluations, all relevant factors, all standards specified in other sections of this ordinance and:
    a. The danger that material may be swept onto other lands to the injury of others.
    b. The danger to life and property due to flooding or erosion damage.
    c. The proposed water supply and sanitation systems and the ability of these systems to prevent disease, contamination, and unsanitary conditions
    d. The susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner.
    e. The importance of the services provided by the proposed facility to the community.
    f. The necessity to the facility of a waterfront location, where applicable.
    g. The availability of alternative locations, not subject to flooding or erosion damage, for the proposed use.
    h. The compatibility for the proposed use with existing development anticipated in the foreseeable future.
    i. The relationship of the proposed use to the comprehensive plan and floodplain management program for that area.
    j. The safety of access to the property in times of flood for ordinary and emergency vehicles.
    k. The expected heights, velocity, duration, rate of rise, and sediment transport of the floodwaters and the effects of wave action, if applicable, expected at the site.
    l. The costs of providing governmental services during and after flood conditions including maintenance and repair of public utilities and facilities such as sewer, gas, electrical and water systems, and streets and bridges.

E. **Additional Conditions:** The Board of Commissioners may place conditions on the use as part of the approval to assure that mitigation measures are associated with the use if written consent to the conditions is obtained by the applicant or the landowner. The conditions shall become part of the Special Use Permit approval and shall be included in the final site plan application.

15.10.3. Effect of Decisions

A. **Appeals:** An appeal from the decision of the Board of Commissioners regarding a Special Use Permit application may be made by an aggrieved party and shall be made to the Superior Court of Wake County in the nature of certiorari. Any such petition shall be filed with the clerk of the superior court within 30 days after the decision of the Board is filed with the Town Clerk, or after a written copy thereof is delivered to every aggrieved party who has filed a written request for such copy with the secretary or chair of the Board at the time of its hearing of the case, whichever is later. The decision of the Board may be delivered to the aggrieved party either by personal service or by registered mail or certified mail return receipt requested.

B. **Permit Validity:** Special Uses that have been granted approval must begin site development within 2 years following approval or the approval becomes invalid.

C. **Permit Extension:** The Board of Commissioners may grant 1 extension of this time period of up to one year upon submittal by the applicant of sufficient justification for the extension. Sufficient justification may include, but is not limited to, delays in other outside agency permits, financing institution delays, or other similar reasons beyond the control of the applicant.

D. **Substantial Changes:** Any substantial change to a Special Use Permit as noted below shall be reviewed by the Board of Commissioners and approved or denied by the Board of Commissioners as an amended Special Use Permit. The following changes to a Special Use Permit shall require approval by the Board of Commissioners:

1. Modification of special performance criteria, design standards, or other requirements specified by the Special Use Permit.
2. A change in land use or development type beyond that permitted by the approved Special Use Permit.
3. When there is introduction of a new vehicular access point to an existing street, road or thoroughfare not previously designated for access.
4. When there is an increase in the total number of residential dwelling units originally authorized by the approved Special Use Permit.
5. When the total floor area of a commercial or industrial classification is increased more than 10% beyond the total floor area last approved by Board of Commissioners. Changes of less than 10% may be approved by the Administrator.
6. Any change which alters the basic development concept of the Special Use Permit.

15.11. HISTORIC PRESERVATION

The historical heritage of the Town of Wake Forest is a valuable and important asset. By listing and regulating historic districts and landmarks, acquiring historic properties, and imposing delays in the demolition of historic structures, the Town of Wake Forest seeks:

- To safeguard the heritage of the town by preserving districts and landmarks therein that embody the special character of the Town and important elements of its culture, history, architectural history, or pre-history; and

- To promote the use and conservation of such districts and landmarks for the education, pleasure, and enrichment of the residents of the town, the County and the State as a whole; and
- To preserve property values and promote the general welfare of its citizens.

15.11.1. Designation of Historic Landmarks/Historic Districts

Upon complying with the required designation procedures set forth herein, the Board of Commissioners may adopt and from time to time amend or repeal an ordinance designating one or more local historic landmarks and/or districts. No property shall be recommended for designation as a landmark or included in a historic district unless it is deemed and found by the Historic Preservation Commission, hereafter referred to as the HPC, to be of special significance in terms of its historical, pre-historical, architectural or cultural importance, and to possess integrity of design, setting, location, workmanship, materials, feeling and/or association.

A. **Process Type:** Legislative.

B. **Inventory of Possible Landmarks:** As a guide for the identification and evaluation of landmarks, the HPC shall maintain an inventory of properties of historical, architectural, pre-historical and cultural significance within the land development jurisdiction of the town.

C. **Applicants:** An application for the designation of property or properties as a historic landmark or district may be submitted by any of the following:

1. The Historic Preservation Commission (HPC),
2. The Board of Commissioners,
3. The Planning Board,
4. The Planning Department, and/or
5. Any resident within the land use jurisdiction of the town.

D. **Required Application Information:** Each application for designation as a historic landmark or district shall contain, at a minimum an Application and a Sketch Plan (15.4.2) that describes the boundaries of the proposed landmark or district and its particular historical, pre-historical, architectural or cultural significance.

E. **Opportunity for Comment from the North Carolina State Historic Preservation Office (SHPO)**

1. Once a complete application is submitted, the Administrator shall prepare a report on the historic, architectural, pre-historical, educational or cultural significance of each building, structure, site, area or object proposed for designation or acquisition. Such report and application shall be forwarded to the SHPO.
2. The State Historic Preservation Office shall be given an opportunity to review and comment upon the substance and effect of the designation of any landmark. All comments will be provided in writing. If the SHPO does not submit its comments to the HPC within 30 days following receipt by the department of the report, the Historic Preservation Commission and the Board of Commissioners shall be relieved of any responsibility to consider such comments.

F. **Creation of Ordinance for Designation**

1. Once a potential landmark or district has been identified, the Administrator shall draft an ordinance for the designation of said property as an official local historic landmark or district.

2. The ordinance shall describe the property designated in the ordinance, the name or names of the owner or owners of the property, those elements of the property that are integral to its historical, architectural or pre-historical value, including the land area of the property so designated and any other information the governing board deems necessary.

G. **Public Notification:** Level 1, 2 & 3 required. Level 5 optional.

H. **Legislative Public Hearing and Decision by the Board of Commissioners:** The HPC and the Board of Commissioners shall hold a joint, legislative public hearing (or separate, legislative public hearings) on the proposed ordinance. Following the legislative public hearing(s), the Board of Commissioners may adopt the ordinance as proposed, adopt the ordinance with any amendments it deems necessary, or reject the proposed ordinance.

I. **Post-Adoption Procedures**

1. Upon adoption of the ordinance the owners and occupants of each landmark shall be given written notification of such designation insofar as reasonable diligence permits.
2. One copy of the ordinance and all amendments thereto shall be filed by the applicant in the offices of the Register of Deeds and the Tax Supervisor of Wake County.
3. A second copy of the ordinance and all amendments thereto shall be kept on file in the office of the Town Clerk and be made available for public inspection at any reasonable time.
4. A third copy of the ordinance and any amendments thereto shall be given to the building inspector for the town.
5. The fact that a building, structure, site or area has been designated a landmark shall be clearly indicated on all tax maps maintained by Wake County for such period as the designation remains in effect.
6. The designation and any recorded restrictions upon the property limiting its use for preservation purposes shall be considered by the tax supervisor in appraising it for tax purposes.
7. A suitable sign for each property designated as a landmark may be placed on the property at the owner's consent; otherwise, a sign may be placed on a nearby right-of-way.

15.11.2. Certificate of Appropriateness – Minor Works (Minor COA)

A. **Applicability:** Minor works are those exterior changes that do not involve substantial alterations, additions or removals that could impair the integrity of the property and/or historic district as a whole.

B. **Process Type:** Administrative

C. **Pre-Application Meeting:** No pre-application conference is required prior to applying for a Minor COA. Applicants are strongly encouraged to call or visit the Administrator prior to submitting an application to determine what information is required for the application.

D. **Required Application Information:** Sketch Plan (15.4.2) and Building Elevations for Design Review (15.4.7) (each may be waived by Administrator as appropriate).

E. **Determination of Compliance:** Once an application containing all needed elements is submitted, the Administrator shall review the application and approve or deny it based on compliance with the standards contained in this chapter and in any applicable Historic District Standards. All decisions shall be in writing and delivered via

electronic mail, personal delivery, or first class mail to the property owner and party seeking determination, if different from the owner.

F. **Public Notification:** N/A

G. **Appeals:** Appeals of the decisions of the Administrator shall be heard by the HPC (15.11.3 below).

H. **Permit Validity:** One year

I. **Permit Extension:** The Administrator may grant one extension of this time period of up to one year upon submittal by the applicant of sufficient justification for the extension. Sufficient justification may include, but is not limited to, delays in other outside agency permits, financing institution delays, or other similar reasons beyond the control of the applicant.

15.11.3. Certificate of Appropriateness – Major Works (Major COA)

A. **Applicability:** Any exterior change that does not qualify for a Minor COA according to the provisions of Section 15.11.2.A.

B. **Process Type:** Quasi-Judicial (See also 15.5)

C. **Pre-Application Meeting:** It shall be the policy of the HPC, in regard to applications involving new construction or extensive alterations and/or additions to existing structures, that a sub-committee of the commission or Town Staff shall be available to meet with persons involved in planned or pending applications in order to advise them informally, at an early stage in the development process. This advice shall be on the Historic District Design Standards, the nature of the area where the proposed project will take place and other relevant factors. In giving such advice, the members of the sub-committee or staff, collectively and individually, shall refrain from any indication of approval or disapproval. Advice or opinions given by any member of the sub-committee at such an informal meeting shall not be considered official or binding upon the commission.

D. **Required Application Information:** Each application for a Major Certificate of Appropriateness shall contain a Sketch Plan (15.4.2), Building Elevations and/or Existing Condition Photographs, and Proposed Materials for Design Review (15.4.7) (each may be waived by Administrator as appropriate). Other information necessary to show that the use or structure complies with the standards set forth in this ordinance and the Historic District Design Standards shall also be provided.

E. **Determination of Compliance:** The Administrator shall review the application to ensure that it is complete, prepare a report and recommendation on the application, and schedule the matter for an evidentiary public hearing before the HPC.

F. **Public Notification:** Level 1 & 3 required.

G. **Evidentiary Public Hearing:** The HPC shall hold an evidentiary hearing on the proposal. The applicant and other property owners likely to be materially affected by the application shall be given an opportunity to be heard.

H. **HPC Review:** Following the evidentiary public hearing the HPC may approve, deny or approve with conditions the application for a Major COA. No Major COA shall be granted unless the HPC finds that the application complies with the Secretary of Interior's Standards for Rehabilitation and the Wake Forest Historic District Design Standards.

I. **Findings of Fact:** The action on an application must be supported by specific findings of fact indicating the extent to which the application is or is not congruous with the special character of the historic district or property.

J. **Review Period by HPC:** Applications for COA's shall be acted upon within 180 days after a complete application is filed, otherwise the application shall be deemed

approved and a certificate shall be issued. An extension of time may be granted by mutual consent of the HPC and the applicant.

K. **Appeals:** According to the provisions of NCGS 160D, an appeal from the decision of the Historic Preservation Commission regarding a Major Certificate of Appropriateness application may be made in the nature of certiorari by an aggrieved party to the Board of Adjustment in accordance with Section 15.12 of this ordinance within 30 days of the decision of the commission.

L. **Permit Validity:** One year

M. **Permit Extension:** The Administrator may grant one extension of this time period of up to one year upon submittal by the applicant of sufficient justification for the extension. Sufficient justification may include, but is not limited to, delays in other outside agency permits, financing institution delays, or other similar reasons beyond the control of the applicant.

15.11.4. Certificate of Appropriateness – Demolition of Historic Structures

A. **Applicability and Authority:** A COA, approved and issued by the HPC subject to the provisions below, is required prior to the demolition, removal or destruction of any of the following historic structures:

1. **Locally Designated Historic Structures:** All locally designated historic landmarks or properties within a historic district pursuant to the authority granted in NCGS 160D, and
2. **Other Historic Structures:** All other historic structures located within the corporate limits and extraterritorial jurisdiction of the Town of Wake Forest pursuant to the authority granted in Session Law 2007-66, House Bill 827 ratified June 7, 2007 by the General Assembly of the State of North Carolina. Such structures shall include those which are:
   a. Designated as a State or national landmark;
   b. Individually listed in the National Register of Historic Places;
   c. Individually identified as a contributing structure in a historic district listed in the National Register of Historic Places;
   d. Certified or preliminarily determined by the Secretary of the Interior as contributing to the significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district;
   e. Individually listed in the State inventory of historic places;
   f. Individually listed in the county Register of Historic Places; or,
   g. Individually listed in the Town of Wake Forest local inventory of historic places, as per Section 15.11.1.B above.

B. **Process Type:** Quasi-Judicial (See also 15.5)

C. **Pre-Application Meeting:** No meeting is required but applicants are encouraged to call or visit the Administrator to determine what information is required for the application.

D. **Required Application Information:** Each application shall contain a Sketch Plan (15.4.2) designating the extent of the proposed demolition, removal or destruction of historic structures.

E. **Determination of Compliance – Locally Designated Historic Structures:** For applications regarding "locally designated historic structures" as outlined in Section 15.11.4.A.1 above, the Administrator shall review the application to ensure that it is complete and schedule the matter for an evidentiary public hearing before the HPC.

F. **Determination of Compliance – Other Historic Structures:** For applications regarding "other historic structures" as outlined in Section 15.11.4.A.2 above, the Administrator shall review the application to ensure that it is complete and assign a Demolition Approval System Score (DASS) as described below. If, according to the DASS table below, a Certificate of Appropriateness is required to authorize the demolition, removal or destruction of a designated landmark or a building, structure or site within a historic district, the Administrator shall schedule the matter for an evidentiary public hearing before the HPC.

G. **Demolition Approval System Score (DASS)**

DASS Tier	Criteria for Assignment of Tier Category*	Required Action
Tier 1	• Appears on the Historic Building Survey Map of the town; OR • Located in an area on the state study list as a potential historic district	Staff shall determine if property is located in an area that is a potential historic district or if the property is a potential for listing on the state study list. If either is true an application for a COA shall be filed by the applicant for review by the HPC. The HPC shall grant a COA authorizing demolition or may order a delay of up to 365 days before demolition may commence. If neither is true (i.e. the site is not in a potential historic district and is not a potential for listing on the state study list) no COA is required and the demolition may proceed without delay.
Tier 2	• Certified or preliminarily determined by the Secretary of the Interior as contributing to the significance of a district preliminarily determined by the Secretary to qualify as a registered historic district; OR • Designated as "non-contributing" in a National Register historic district; OR • Individually listed in the state study list; OR • Individually listed in any county or local inventory of historic buildings or sites	An application for a COA shall be filed by the applicant for review by the HPC. The HPC shall grant a COA authorizing demolition or may order a delay of up to 365 days before demolition may commence.
DASS Tier	**Criteria for Assignment of Tier Category***	**Required Action**
Tier 3	• Individually designated landmark; OR • Individually listed in National Register; OR • Designated as "contributing" in a National Register historic district	An application for a COA shall be filed by the applicant for review by the HPC. The HPC shall grant a COA authorizing demolition or may order a delay of up to 365 days before demolition may commence. (A Tier 3 DASS score will likely result in an automatic delay of 365 days.)
None	• None of the above criteria apply.	No delay of demolition. No COA required.
* A property shall be classified in the highest Tier Category for which it meets the criteria		

H. Public Notification: Level 1 & 3 required.

I. **Evidentiary Public Hearing:** The HPC shall hold an evidentiary hearing on the proposal. The applicant and other property owners likely to be materially affected by the application shall be given an opportunity to be heard.

J. **HPC Review – Locally Designated Historic Structures:** An application for a Certificate of Appropriateness authorizing the demolition, removal or destruction of a "locally designated historic structure," as outlined in Section 15.11.4.A.1 above, may not be denied or delayed except as provided below:

1. The effective date of such a certificate may be delayed for up to 365 days from the date of approval. The period of delay should be reduced by the HPC if it finds that the owner would suffer extreme hardship or be permanently deprived of all beneficial use or return from such property by virtue of the delay.
2. During the delay period the HPC shall negotiate with the owner in an effort to find a means of preserving the building, structure or site.
3. If the HPC finds that a building, structure or site has no special significance or value toward maintaining the character of a district, it shall waive all or part of such period of delay and authorize earlier demolition or removal.
4. If the HPC has voted to recommend the designation of a landmark or the designation of an area as a historic district, and final designation has not been made by the Board of Commissioners, the demolition or destruction of any building, structure or site in the proposed district or of the designated landmark may be delayed by the commission for up to 365 days after the Board of Commissioners takes final action on the designation.
5. An application for a Major Certificate of Appropriateness authorizing the demolition of a building, structure or site determined by the State of North Carolina's Historic Preservation Officer as having statewide significance as defined in the criteria of the National Register of Historic Places may be denied except where the HPC finds that the owner would suffer extreme hardship or be permanently deprived of all beneficial use or return by virtue of the denial.

K. **HPC Review – Other Historic Structures:** An application for a COA authorizing the demolition, removal or destruction of "other historic structures" as outlined in Section 15.11.4.A.2 above, shall be evaluated by the HPC based on 4 standards which will be weighed using a point scale of 0 to 2, where 0 means that the structure does not meet the standard, 1 means the structure moderately meets the standard, and 2 means the structure significantly meets the standard. A total score of 4 or greater will result issuance of a COA with an order for delay of demolition for 365 days from the date in the COA. A total score of less than 4 may result in the issuance of a COA with a delay of less than 365 days or no delay of demolition. The standards are as follows:

1. **Architectural Integrity**
   a. The structure has maintained the integrity of its original architectural form.
   b. Changes made to the structure over 50 years ago have gained historic significance.
2. **Architectural Style**
   a. The structure has a distinctive architectural style.
   b. It has superior craftsmanship.
   c. The structure is the last or oldest example of a certain building type.
   d. It is one of a cluster of buildings that are significant as a group.
3. **Cultural Significance:** The structure is culturally significant due to factors such as its historic use, an event, a person, a builder, or an architect associated with the structure.
4. **Structural Integrity**
   a. The structure will be given a score of 2 points for structural integrity unless the applicant has provided an engineer's report stating otherwise.
   b. Said report will be paid for by the applicant using a structural engineer recommended by the SHPO.

c. The structural components – roof, wall, floor, and foundation systems will each have a value of ½ point.

d. If the report states that a system is structurally unsound the score of 2 will be reduced by ½ point per system rated at 50% or more unsound.

L. **HPC Decision and Findings of Fact:** The action on an application must be supported by specific findings of fact indicating the extent to which the application meets the provisions above. The HPC may choose to include previous documented time spent in the search for an alternative to demolition, such as moving the structure, as part of any required delay of demolition.

M. **Review Period by HPC:** Applications for COA shall be acted upon within 180 days after a complete application is filed, otherwise the application shall be deemed approved and a certificate shall be issued. An extension of time may be granted by mutual consent of the HPC and the applicant.

N. **Immediate Demolition – Other Historic Structures:** For applications regarding "other historic structures" as outlined in Section 15.11.4.A.2 above, the applicant may avoid a delay in demolition imposed by the HPC if the State Building Inspector orders the immediate demolition of the structure, or if the applicant makes a claim of unsafe conditions according to the following provisions.

1. Any application for demolition of a Tier 2 or 3 structure must include documentation as to the condition of the property to support a claim of unsafe conditions.
2. This documentation shall be in the form of a report from a structural engineer recommended by the SHPO and paid for by the applicant. This report shall specifically address the roof, wall, floor, and foundation systems rated as a percentage structurally unsound.
3. If the structure to be demolished is an accessory structure, a similar report from the town building inspector may be submitted for the engineer's report although the HPC may require that the applicant return with an engineer's report at the applicant's expense.
4. The HPC may also require an engineer's report for any Tier 1 property at their discretion and at the applicant's expense based on the considerations of the specific site.
5. A structure found to be unsafe shall not automatically be issued a COA with no delay of demolition. The COA may be issued with a delay of demolition and an order for stabilization or shoring in order to avoid demolition by neglect.

O. **Salvage of Materials – Other Historic Structures:** For applications regarding "other historic structures" as outlined in Section 15.11.4.A.2 above, the applicant shall make all materials available to salvagers prior to demolition according to the provisions below.

1. Such materials may be sold to a salvage company or any other interested party, donated to "Habitat for Humanity" or similar organizations, given away to individuals, businesses, or other organizations, or any combination thereof.
2. The applicant must publically advertise, at least two weeks prior, a date and time for any interested materials salvager or other interested parties to visit the building to be demolished and arrange to acquire any desired salvage materials. The requirement of advertising may be waived by staff or the HPC when the salvage is handled in another acceptable manner or the potential salvage is of minimal value.

3. The applicant shall time the collection of materials in a logical manner, such as doors, windows, fireplace surrounds and mantels, cabinets, fixtures, etc will be collected prior to wood flooring, although carpets could be collected early.
4. At the time the salvaged materials are collected the applicant or their agent must be on site to assure that materials are not damaged in the acquisition of other materials.

P. **Appeals:** According to the provisions of NCGS 160D, an appeal from the decision of the HPC regarding a Major Certificate of Appropriateness application may be made by an aggrieved party in the nature of certiorari to the Board of Adjustment in accordance with Section 15.12 of this ordinance within 30 days of the decision of the commission.

Q. **Permit Validity:** One year

R. **Permit Extension:** The Administrator may grant one extension of this time period of up to one year upon submittal by the applicant of sufficient justification for the extension. Sufficient justification may include, but is not limited to, delays in other outside agency permits, financing institution delays, or other similar reasons beyond the control of the applicant.

15.12. APPEALS OF ADMINISTRATIVE DECISIONS

15.12.1. Applicability

This process is hereby established to provide an appeal process for the following:

A. Parties aggrieved by any order, requirement, decision or determination, made by an administrative officer charged with enforcing the provisions of this ordinance, and,

B. Parties aggrieved by the decision of the HPC regarding Major COA according to the appellate procedure outlined in NCGS 160D.

15.12.2. Filing Procedures

A. **Process Types:** Quasi-Judicial (See also 15.5)

B. **Filing Procedure:** An appeal of an administrative decision may be taken by any person aggrieved (or by their authorized agent), or by any officer, department or board of the town, to the Board of Adjustment. Such an appeal shall be made within 30 days of the receipt by such aggrieved party of the written notice of decision from the Administrator, or in the case of an office, department or board of the town, within 30 days of the filing of the written notice with the Town Clerk.

C. **Stay of Proceedings:** The filing of an appeal shall stay all proceedings in furtherance of the contested action unless the Administrator certifies that, in his/her opinion, by reason of facts stated in the certification, such a stay would cause imminent peril to life and property. In such a case, proceedings shall not be stayed except by restraining order or preliminary injunction granted by the Superior Court of Wake County in accordance with Rule 65 of the North Carolina Rules of Civil Procedure.

D. **Required Appeal Application Information:** Such relevant information as may reasonably allow the Board of Adjustment to understand the basis for the applicant's appeal. The Administrator shall similarly prepare a report detailing the regulations and interpretation behind the matter being appealed and their reason for their decision.

E. **Public Notification:** Level 1 & 2 required.

15.12.3. Formal Review

A. Upon receiving the application, the Board of Adjustment shall conduct an evidentiary public hearing on the appeal. Any party may appear in person or be represented by an agent at the evidentiary hearing.

B. After conducting the evidentiary public hearing, the Board of Adjustment shall adopt an order reversing or affirming, wholly or in part, or modifying the order requirements, decision or determination in question. It shall take a 4/5ths vote of the Board of Adjustment to reverse or modify the contested action.

C. The Board of Adjustment, in making its ruling, shall have all the powers of the Administrator from whom the appeal is taken, and may issue or direct the issuance of a permit.

D. The decision of the Board of Adjustment must be in writing and permanently filed in the minutes of that reviewing body as a public record. All findings of fact and conclusions of law must be separately stated in final decisions or orders of the Board of Adjustment, which must be delivered to parties of interest by certified mail.

15.12.4. Appeals

A. Any appeal from a decision of the Board of Adjustment may be made by an aggrieved party and shall be made to the Superior Court of Wake County in the nature of certiorari. Any such petition shall be filed with the clerk of the superior court within 30 days after the decision of the Board is filed with the Town Clerk, or after a written copy thereof is delivered to every aggrieved party who has filed a written request for such copy with the secretary or chairman of the Board at the time of its hearing of the case, whichever is later. The decision of the Board may be delivered to the aggrieved party either by personal service or by registered mail or certified mail return receipt requested.

B. Any appeal from a decision relating to sedimentation and erosion control shall be made to the North Carolina Sedimentation Control Commission.

15.13. VARIANCES

15.13.1. Applicability

A. **Purpose:** The variance process administered by the Board of Adjustment is intended to provide limited relief from the requirements of this ordinance in those cases where strict application of a particular requirement will create a practical difficulty or unnecessary hardship prohibiting the use of the land in a manner otherwise allowed under this ordinance.

B. **Sufficient Grounds for Variance:** It is not intended that variances be granted solely to remove inconveniences or financial burdens that the requirements of this ordinance may impose on property owners in general or to increase the profitability of a proposed development, although such factors can be taken into consideration.

C. **Use Variances Not Permitted:** In no event shall the Board of Adjustment grant a variance which would allow the establishment of a use which is not otherwise allowed in a land development district or which would change the land development district classification or the district boundary of the property in question.

D. **Authority Limited to this Ordinance/Conflicts with other Laws Prohibited:** In no event shall the Board of Adjustment grant a variance which would conflict with any state code unless otherwise authorized by laws and regulations.

15.13.2. Filing Procedures

A. **Process Types:** Quasi-Judicial (See also 15.5)

B. **Pre-Application Procedure:** Every applicant for a variance is strongly encouraged to meet with the planning department in a pre-application conference prior to the submittal of a request for a variance. The purpose of this conference is to provide additional information regarding the review process and assistance in the preparation of the application.

C. **Filing Procedure:** An application for a variance may be filed by the owner of the property or by an agent specifically authorized by the owner to file such application.

D. **Required Application Information:** All information relevant to describing the applicant's request to the Board of Adjustment.

E. **Public Notification:** Level 1, 2 & 4 required.

F. **Determination of Compliance:** Staff shall review an application for a variance to determine if it is complete. If an application is complete, the Administrator shall schedule the matter for consideration at a meeting of the Board of Adjustment. The Administrator shall prepare a staff report regarding the submitted variance application.

15.13.3. Formal Review

A. **Action by the Board of Adjustment**

1. Upon receipt of the request for a variance from the Administrator, the Board of Adjustment shall hold a quasi-judicial evidentiary hearing on the request.
2. After conducting the evidentiary hearing, the Board of Adjustment may: deny the application; conduct an additional evidentiary public hearing on the application; approve the application; or approve the application with additional conditions. A concurring vote of four-fifths of the members of the Board of Adjustment shall be necessary to grant a variance.
3. A decision by the Board of Adjustment shall be made within 45 days of the date of the evidentiary hearing.
4. Any approval or denial of the request shall be accompanied by written findings of fact supporting the conclusion that the variance meets or does not meet each of the standards set forth below.

B. **Standard of Review:** The Board of Adjustment shall not grant a variance unless and until it makes all of the following findings:

1. Carrying out the strict letter of the ordinance would result in an unnecessary hardship. It shall not be necessary to demonstrate that, in the absence of the variance, no reasonable use can be made of the property.
2. The hardship results from conditions that are peculiar to the property, such as location, size, or topography. Hardships resulting from personal circumstances, as well as hardships resulting from conditions that are common to the neighborhood or the general public, may not be the basis for granting a variance.
3. The hardship did not result from actions taken by the applicant of the property owner. The act of purchasing property with knowledge that circumstances exist that may justify the granting of a variance shall not be regarded as a self-created hardship.
4. The requested variance is consistent with the spirit, purpose, and intent of this ordinance, such that the public safety is secured, and substantial justice is achieved.

C. **Additional Standards for Floodplain, Watershed and Stormwater Regulation Variance Requests**: Variances from the standards set forth in this ordinance for flood

damage prevention, watershed protection and stormwater regulation may be granted subject to the following additional provisions:

1. Variances shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result or when the variance will make the structure in violation of other federal, state or local laws.
2. Variances shall only be issued upon:
    a. A determination that the variance is the minimum necessary, considering the flood hazard, to afford relief;
    b. A showing of good and sufficient cause;
    c. A determination that failure to grant the variance would result in exceptional hardship; and,
    d. A determination that the granting of a variance will not result in a substantial increase in flood heights, additional threats to public safety, extraordinary public expense, create nuisance, cause fraud on or victimization of the public, or conflict with existing laws or ordinances.
3. In passing upon variances, the Board of Adjustment shall consider all technical evaluations, all relevant factors, all standards specified in other sections of this chapter and:
    a. The danger that material may be swept onto other lands to the injury of others.
    b. The danger to life and property due to flooding or erosion damage.
    c. The susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner.
    d. The importance of the services provided by the proposed facility to the community.
    e. The availability of alternative locations, not subject to flooding or erosion damage, for the proposed use.
    f. The compatibility of the proposed use with existing and anticipated development.
    g. The relationship of the proposed use to the land development plan and flood damage prevention program for that area.
    h. The safety of access to the property in times of flood for ordinary and emergency vehicles.
    i. The expected heights, velocity, duration, rate of rise, and sediment transport of the floodwaters and the effects of wave action, if applicable, expected at the site.
    j. The costs of providing governmental services during and after flood conditions including maintenance and repair of public utilities and facilities such as sewer, gas, electrical and water systems, and streets and bridges.
4. Any applicant to whom a variance from the floodplain development regulations is granted shall be given written notice. This notice shall specify the difference between the base flood elevation and the elevation to which the structure is to be built and contain a written statement that such construction below the Base Flood Elevation increases risks to life and property, and that the issuance of a variance to construct a structure below the Base Flood Elevation will result in increased premium rates for flood insurance up to $25 per $100 of insurance coverage. Such notification shall be maintained with a record of all variance

actions. Variances records shall be provided to the Federal Emergency Management Agency upon request.

D. **Additional Conditions**: In granting any variance, the Board of Adjustment may attach such conditions to the approval as it deems necessary and appropriate to satisfy the purposes and objectives of this ordinance. The Board of Adjustment may also attach conditions in order to reduce or minimize any injurious effect of such variance upon other property in the neighborhood and to ensure compliance with other terms of this ordinance. Such conditions and safeguards must be reasonably related to the condition or circumstance that gives rise to the need for a variance.

15.13.4. Appeals

An appeal from the decision of the Board of Adjustment regarding a variance request may be made by an aggrieved party and shall be made to the Superior Court of Wake County in the nature of certiorari. Any such petition shall be filed with the clerk of the superior court within 30 days after the decision of the Board is filed with the Town Clerk, or after a written copy thereof is delivered to every aggrieved party who has filed a written request for such copy with the secretary or chairman of the Board at the time of its hearing of the case, whichever is later. The decision of the Board may be delivered to the aggrieved party either by personal service or by registered mail or certified mail return receipt requested.

15.14. TEXT AMENDMENTS AND MAP AMENDMENTS (REZONINGS)

The Board of Commissioners may from time to time amend any part of the text of this ordinance or amend the Zoning Map of the town.

15.14.1. Application Procedures

A. **Process** Types: Legislative

B. **Applicants**: Map or text amendments may be submitted by any of the following:

1. The Board of Commissioners,
2. The Planning Board,
3. The Planning Department, and/or
4. Any resident or property owner within the land use jurisdiction of the town, a lessee or person holding an option or contract to purchase or lease land, or an authorized agent of the landowner, provided that any rezoning or text amendment requests that down zone property, thereby reducing allowable density or reducing the number of allowable uses, shall obtain written consent by all property owners of such impacted property.

C. **Pre-Application Procedure:** Before filing a petition of an amendment, an applicant (if an owner requesting a map amendment) shall meet with the Administrator to discuss the proposed amendment or request and to become more familiar with the applicable requirements and approval procedures of the town.

D. **Content of Application:** A petition for an amendment to the town's official zoning map or text shall be filed on a form provided by the Administrator. Such a petition shall contain all the information required on the form and must be determined to be complete by the Administrator prior to advancing it through the review process.

E. **Determination of Compliance:** Staff shall review an application for amendment to determine if it is complete. If an application is complete, the Administrator shall schedule the matter for consideration at a meeting of the Planning Board. The Administrator shall prepare a staff report and recommendation on the matter.

15.14.2. Review By Planning Board

A. **Public Comment Session Notification (Prior to Planning Board):** Level 1, as defined in Section 15.3, is required for all amendments to the UDO. Levels 3 and 4 are required for all map amendments (rezonings) that involve a specific parcel of land. Such actions include, but are not limited to, map amendments (rezonings), amendments to zoning district boundaries, and the application of new overlay zones. A Level 5 notification is required for Map Amendments.

B. **Level 3 Notification for Large Scale Amendments:** If the land development map amendment includes 50 or more properties, owned by at least 50 different property owners, the town may elect to utilize the expanded published notice provisions found in NCGS 160D, as outlined in Section 15.3.3.B of this chapter.

C. **Public Comment Session:** The Planning Board shall conduct a public comment session and receive public input on the proposed amendment. Following the comment session to receive public input on the amendment, the Planning Board shall make a recommendation to the Board of Commissioners regarding whether to approve or deny each proposed amendment and shall comment on the consistency of the request with the adopted plans.

D. **Delivery of Planning Board Recommendation:** If the Planning Board is able to reach a recommendation without further deliberation, the Planning Board shall submit a recommendation on the matter and refer it to the Board of Commissioners for their consideration at their regularly scheduled legislative public hearing directly following the public comment session. If the Planning Board determines that further deliberation on the matter is required, the Planning Board shall render a decision on its recommendation to the Board of Commissioners within 45 days of its first consideration on the matter. If no recommendation is received from the Planning Board within 45 days of it first consideration on the matter, the Board of Commissioners shall proceed in its consideration of the matter without a recommendation from the Planning Board.

15.14.3. Citizen Comments

A. **Written Statement of Citizen Concern:** If any resident or property owner in the Town submits a written statement regarding a proposed amendment, modification, or repeal to this ordinance to the Town Clerk at least two business days prior to the proposed vote on such change, the Town Clerk shall deliver such written statement to the Board of Commissioners. If the proposed change is the subject of a quasi-judicial proceeding under NCGS 160D, the Town Clerk shall provide only the names and addresses of the individuals providing written comment, and provisions of such names and addresses to all members of the Board of Commissioners shall not disqualify any member of the Board of Commissioners from voting.

B. **Withdrawal of Written Statement:** Any resident or property owner who submits a written statement of citizen concern may withdraw their written statement any time prior to the meeting at which the item will be considered.

15.14.4. Consideration By Board of Commissioners

A. **Public Hearing Notification:** Level 1 and 2, as defined in Section 15.3, are required for all amendments to the UDO. Levels 3 and 4 are required for all map amendments (rezonings) that involve a specific parcel of land. Such actions include, but are not limited to, map amendments (rezonings), amendments to zoning district boundaries, and the application of new overlay zones. A Level 5 notification is required for Map Amendments.)

B. **Level 3 Notification for Large Scale Amendments:** If the land development map amendment includes 50 or more properties, owned by at least 50 different property owners, the town may elect to utilize the expanded published notice provisions found in NCGS 160D, as outlined in Section 15.3.3.B of this chapter.

C. **Public Hearing Consideration by the Board of Commissioners:** Following receipt of a recommendation from the Planning Board, or after 45 days from the Planning Board public comment session if no recommendation is received, the Board of Commissioners shall conduct a legislative public hearing on the matter. Upon reviewing all of the pertinent information, the Board of Commissioners may:

1. Adopt the proposed amendment by ordinance.
2. Adopt the proposed amendment with modifications by ordinance.
3. Reject the proposed amendment.
4. Refer the proposed amendment back to the Planning Board for further consideration.

15.14.5. Plan Consistency

In accordance with G.S. 160D, all such amendments shall be made in accordance with the Community Plan and any other officially adopted applicable plan. The Planning Board shall advise and comment on whether the proposed amendment is consistent with any comprehensive plan that has been adopted and any other officially adopted plan that is applicable. When adopting or rejecting any zoning amendment, the Board of Commissioners shall adopt by resolution a statement describing whether its action is consistent with the adopted comprehensive plan and explaining why the Board of Commissioners considers the action taken to be reasonable and in the public interest.

15.14.6. Waiting Period For Subsequent Applications

A. After an application for an amendment has been approved or denied by the Board of Commissioners, there shall be a 6 month waiting period before an application shall be considered on the same issue.

B. This waiting period may be waived by the Board of Commissioners (three-fourths vote required) if it determines that there have been substantial changes in conditions or circumstances which may relate to the request.

15.15. CONDITIONAL ZONING (CD)

Conditional Districts (CD) (see Section 2.6) are districts with conditions voluntarily added by the applicant and approved in a legislative procedure by the Board of Commissioners in accordance with G.S. 160D via the conditional zoning process. Conditional Districts provide for orderly and flexible development under the general policies of this ordinance without the constraints of some of the prescribed standards guiding by-right development. Conditional zoning may be requested in any district but is not intended to relieve hardships that would otherwise be handled using a variance procedure.

15.15.1. Application Procedures

A. **Process Types:** Legislative

B. **Applicant and Property:** Conditional zoning shall only be considered upon the request of the owners and/or their representatives of all the property to be included in the specific Conditional District. A Conditional District shall consist of land under unified control which may be planned and developed as a single development or as an approved programmed series of development phases by multiple developers. "Unified control" means that all land to be included within a Conditional District shall be owned

or otherwise under the legal control of the applicant for a conditional zoning request. The applicant shall be legally capable of providing a commitment to the town that the Conditional District development will comply with all documents, plans, standards and conditions ultimately approved by the town.

C. **Fair and Reasonable Conditions:** Within an approved Conditional District, no use shall be permitted except pursuant to the conditions imposed by the applicant on the Conditional District in the approval of the rezoning. All conditions shall be in writing and signed by all property owners. The Board of Commissioners and the applicant may mutually agree to additional reasonable and appropriate conditions or safeguards to serve the purpose and intent of this section, and to preserve public welfare, and justice. The provisions of the Conditional District Master Plan shall replace all conflicting development regulations set forth in this ordinance which would otherwise apply to the development site. The Planning Board may recommend and the Board of Commissioners (with mutual approval of the applicant) may attach reasonable and appropriate conditions including, but not limited to, the location, nature, hours of operation, and extent of the proposed use(s). Conditions and site-specific standards shall be limited to those that address conformance of the development and use of the site to this ordinance and officially adopted plans and those standards and conditions that address the impacts reasonably expected to be generated by the development and use of the site. The applicant will have a reasonable opportunity to consider and respond to any conditions and site-specific standards proposed by either the Planning Board or the Board of Commissioners prior to final action.

D. **Content of Application:** A conditional zoning shall consist of the Existing Conditions Map (15.4.1), written and signed conditions, and Master Plan (15.4.3); as well as any other plans, drawings, renderings, elevations, maps and documents specifically included as development documents for approval by the Board of Commissioners. The Conditional District Master Plan, is a site specific that is a condition of the conditional zoning. In addition to those items required for Master Plans in Section 15.4.3, a Conditional District Master Plan shall, at a minimum, illustrate the following:

1. The underlying zoning districts and a full list of proposed uses consistent in character with those zoning districts. Such use classifications may be selected from any of the uses, whether permitted, by right or with supplemental standards, allowed in the general zoning district upon which the Conditional District is based. Uses not otherwise permitted within the general zoning district shall not be permitted within the Conditional District;
2. General traffic routes (external and internal) to and from the development with major access points identified;
3. Tabular data, including the range and scope of proposed land uses, proposed densities, floor area ratios and impervious surface ratios as applicable to development type; and land areas devoted to each type of general land use and phase of development;
4. A proposed development schedule if the project is to be phased.

E. **Exception for Conditional Zoning with Use Limitations Only:** If an applicant proposes a conditional zoning which meets the following criteria, no Conditional District Master Plan shall be required in the application:

1. The only proposed deviation in use from the underlying zoning is to impose additional limitations on the uses that will be allowed in the Conditional District.
2. No other deviations from the standards of the underlying zoning are proposed in the Conditional District.

15.15.2. Formal Review

The procedure for approval of a conditional zoning shall follow the procedure for review of Text & Map Amendments (Rezonings) as outlined in Sections 15.4.2 through 15.4.6.

15.15.3. Effect of Approval/Changes

The applicant may proceed with development only after approval of the Conditional District Master Plan by the Board of Commissioners, followed by approval of any necessary Construction Plans and Plats, except that all subsequent approvals shall be completed by the Administrator. The development and use of all land within the Conditional District shall be in keeping with the approved Master Plan and all applicable provisions therein.

A. **Final Approval by Stages:** If so reflected on the Master Plan, the Board of Commissioners may allow the phasing of final development. Each phase of development shall adhere to all applicable provisions and standards of this section and the applicable Conditional District Master Plan.

B. **Substantial Changes:** Any substantial change to a Master Plan as noted below shall be reviewed by the Planning Board and approved or denied by the Board of Commissioners as an amended Conditional District. The following changes to a Conditional District Master Plan shall require approval by the Board of Commissioners:

1. Land area being added or removed from the Conditional District.
2. Modification of special performance criteria, design standards, or other requirements specified by the enacting ordinance.
3. A change in land use or development type beyond that permitted by the approved Conditional District Master Plan.
4. When there is introduction of a new vehicular access point to an existing street, road or thoroughfare not previously designated for access.
5. When there is an increase in the total number of residential dwelling units originally authorized by the approved Conditional District Master Plan.
6. When the total floor area of a non-residential classification is increased more than 10% beyond the total floor area last approved by Board of Commissioners. Changes of less than or equal to 10% may be approved by the Administrator.
7. Any change which alters the basic development concept of the Conditional District Master Plan.
8. **Other Changes:** All other changes to a Conditional District Master Plan shall receive approval from the Board of Adjustment.

15.16. Planned Unit Development (PUD)

Planned Unit Development (PUD) districts (see Section 2.7) are districts that permit variations to allow flexibility to creatively plan a site specific, high quality overall development of their land that is not possible through the strict application of the minimum standards of the Ordinance and are approved in a legislative procedure by the Board of Commissioners in accordance with G.S. 160D. Planned Unit Developments provide for orderly and flexible development under the general policies of this ordinance without the constraints of some of the prescribed standards guiding by-right development.

15.16.1. General Applicability

A. Before any development shall be designated as a Planned Unit Development (PUD) District on the Official Zoning District Map, it shall receive approval pursuant to the terms of this Section and Sec. 2.7 Planned Unit Developments.

B. A Planned Unit Development (PUD) designation may be established on any land located in the Town and its ETJ that complies with all of the applicable standards of this Section.

15.16.2. Application Procedures

A. **Process Types:** Legislative

B. **Applicant and Property**: Planned Unit Development classification shall only be considered upon the request of the owners and/or their representatives of all the property to be included in the specific Planned Unit Development request. A Planned Unit Development shall consist of land under unified control which may be planned and developed as a single development or as an approved programmed series of development phases by multiple developers. "Unified control" means that all land to be included within a Planned Unit Development shall be owned or otherwise under the legal control of the applicant for a Planned Unit Development. The applicant shall be legally capable of providing a commitment to the town that the Planned Unit Development will comply with all documents, plans, standards and conditions ultimately approved by the town.

C. **Fair and Reasonable Conditions:** Within an approved Planned Unit Development, no use shall be permitted except pursuant to the conditions imposed by the applicant on the Planned Unit Development in the approval of the zoning map change. The Board of Commissioners and the applicant may mutually agree to additional reasonable and appropriate conditions or safeguards to serve the purpose and intent of this section, and to preserve public welfare, and justice. The provisions of the Planned Unit Development Concept Plan shall replace all conflicting development regulations set forthin this ordinance which would otherwise apply to the development site. The Planning Board may recommend and the Board of Commissioners (with mutual approval of the applicant) may attach reasonable and appropriate conditions including, but not limited to, the location, nature, hours of operation, and extent of the proposed use(s). Conditions and site-specific standards shall be limited to those that address conformance of the development and use of the site to this ordinance and officially adopted plans and those standards and conditions that address the impacts reasonably expected to be generated by the development and use of the site. The applicant will have a reasonable opportunity to consider and respond to any conditions and site-specific standards proposed by either the Planning Board or the Board of Commissioners prior to final action. All conditions shall be in writing and signed by all property owners.

D. **Content of Application:** A Planned Unit Development shall consist of the Existing Conditions Map (15.4.1), and Concept Plan (15.4.4); as well as any other plans, drawings, renderings, elevations, maps and documents specifically included as development documents for approval by the Board of Commissioners. The Concept Plan is a site-specific plan that is a condition of the Planned Unit Development zoning map change. A Planned Unit Development Concept Plan shall, at a minimum, illustrate the following:

1. The underlying zoning district or overlay district uses and requirements shall not apply to the Planned Unit Development unless explicitly incorporated into the standards of the PUD Plan.
2. General traffic routes (external and internal) to and from the development with major access points identified;
3. Tabular data, including the range and scope of proposed land uses, proposed densities, floor area ratios and impervious surface ratios as applicable to

development type; and land areas devoted to each type of general land use and phase of development;

4. A proposed development schedule if the project is to be phased.

15.16.3. Formal Review

The procedure for approval of a Planned Unit Development shall follow the procedure for review of Text & Map Amendments (Rezonings) as outlined in Sections 15.4.2 through 15.4.6.

15.16.4. Effect of Approval/Changes

The applicant may proceed with development only after approval of the Planned Unit Development Concept Plan by the Board of Commissioners, followed by any necessary approvals typically required of this ordinance. The development and use of all land within the Planned Unit Development shall be in keeping with the approved Concept Plan and all applicable provisions therein.

A. **Final Approval by Stages:** If indicated on the PUD Concept Plan, the Board of Commissioners may allow the phasing of final development. Each phase of development shall adhere to all applicable provisions and standards of this section and the applicable Planned Unit Development Concept Plan.

B. **Substantial Changes:** Any substantial change to a PUD Concept Plan as noted below shall be reviewed by the Planning Board and approved or denied by the Board of Commissioners as an amended Planned Unit Development. The following changes to a Planned Unit Development Concept Plan shall require approval by the Board of Commissioners:

1. Land area being added or removed from the Planned Unit Development.
2. Modification of special performance criteria, design standards, or other requirements specified by the enacting ordinance.
3. A change in land use or development type beyond that permitted by the approved Planned Unit Development Concept Plan.
4. When there is introduction of a new vehicular access point to an existing street, road or thoroughfare not previously designated for access.
5. When there is an increase in the total number of residential dwelling units originally authorized by the approved Planned Unit Development Concept Plan.
6. When the total floor area of a non-residential classification is increased more than 10% beyond the total floor area last approved by Board of Commissioners. Changes of less than or equal to 10% may be approved by the Administrator.
7. Any change which alters the basic development concept of the Planned Unit Development Concept Plan.
8. **Other Changes:** All other changes to a Planned Unit Development Concept Plan shall receive approval from the Board of Commissioners.

C. **Planned Unit Development Concept Plan Expiration:** The Applicant shall secure a valid building or construction permit(s) within five (5) years from date of approval of the Planned Unit Development unless otherwise specified. If such project is not complete or a valid building permit is not in place at the end of the five (5) year period, the Administrator shall notify the applicant of either such finding and a new TIA shall be required as well as an updated PUD Concept Plan must be submitted. The Administrator shall make a recommendation concerning the extension of the Planned Unit Development to the Board of Commissioners. The Board of Commissioners may then rescind the Planned Unit Development, or extend the life of the Planned Unit

Development for a specified period of time. The rescission of a Planned Unit Development shall follow the same procedure as was needed for approval.

15.17. COMPREHENSIVE PLAN AMENDMENT

The Board of Commissioners may from time to time amend any part of the text or maps of comprehensive plans of the town.

15.17.1. Application Procedures

A. **Process**: Legislative

B. **Applicants**: Map or text amendments may be submitted by any of the following:

1. The Board of Commissioners,
2. The Planning Board,
3. The Planning Department, and/or
4. Any resident or property owner within the land use jurisdiction of the town.

C. **Pre-Application Procedure**: Before filing a petition of an amendment, an applicant (if an owner requesting a map amendment) shall meet with the Administrator to discuss the proposed amendment or request and to become more familiar with the applicable requirements and approval procedures of the town.

D. **Content of Application**: A petition for an amendment to the town's comprehensive plans, map or text, shall be filed on a form provided by the Administrator. such a petition shall contain all the information required on the form and must be determined to be complete by the Administrator prior to advancing it through the review process. per NCGS 160D, if a petition for an amendment is submitted concurrently with a zoning map amendment (rezoning), a separate application and fee are not required for the plan amendment.

E. **Determination of Compliance**: Staff shall review an application for amendment to determine if it is complete. if an application is complete, the Administrator shall schedule the matter for consideration at a meeting of the Planning Board. the Administrator shall prepare a staff report and recommendation on the matter.

15.17.2. Review By The Planning Board

A. **Public Comment Session Notification (Prior to Planning Board):** Level 1, as defined in Section 15.3, is required for all amendments to the comprehensive plan. Levels 3 and 4 are only required for land use map amendments. ~~Levels 3 and 4 are required for all map amendments that involve a specific parcel of land. A Level 5 notification is required for Map Amendments.~~

~~**B.** **Level 3 Notification for Large Scale Amendments:** If the land development map amendment includes 50 or more properties, owned by at least 50 different property owners, the town may elect to utilize the expanded published notice provisions found in NCGS 160D, as outlined in Section 15.3.3.B of this chapter.~~

~~**C.**~~**B.** **Public Comment Session:** The Planning Board shall conduct a public comment session and receive public input on the proposed amendment. Following the comment session to receive public input on the amendment, the Planning Board shall make a recommendation to the Board of Commissioners regarding whether to approve or deny each proposed amendment.

~~**D.**~~**C.** **Delivery of Planning Board Recommendation:** If the Planning Board is able to reach a recommendation without further deliberation, the Planning Board shall submit a recommendation on the matter and refer it to the Board of Commissioners for their consideration at their regularly scheduled legislative public hearing directly following

the public comment session. If the Planning Board determines that further deliberation on the matter is required, the Planning Board shall render a decision on its recommendation to the Board of Commissioners within 45 days of its first consideration on the matter. If no recommendation is received from the Planning Board within 45 days of it first consideration on the matter, the Board of Commissioners shall proceed in its consideration of the matter without a recommendation from the Planning Board.

15.17.3. Citizen Comments

A. **Written Statement of Citizen Concern:** If any resident or property owner in the Town submits a written statement regarding a proposed amendment to the comprehensive plan to the Town Clerk at least two business days prior to the proposed vote on such change, the Town Clerk shall deliver such a written statement to the Board of Commissioners.

B. **Withdrawal of Written Statement:** Any resident or property owner who submits a written statement of citizen concern may withdraw their written statement any time prior to the meeting at which the item will be considered.

15.17.4. Consideration By Board of Commissioners

A. **Public Hearing Notification:** Level 1 and 2, as defined in Section 15.3, are required for all amendments to the UDO. Levels 3 and 4 are only required for land use map amendments. ~~Levels 3 and 4 are required for all map amendments (rezonings) that involve a specific parcel of land. Such actions include, but are not limited to, map amendments (rezonings), amendments to zoning district boundaries, and the application of new overlay zones. A Level 5 notification is required for Map Amendments.)~~

B. **Public Hearing Consideration by the Board of Commissioners:** Following receipt of a recommendation from the Planning Board, or after 45 days from the Planning Board public comment session if no recommendation is received, the Board of Commissioners shall conduct a legislative public hearing on the matter. Upon reviewing all of the pertinent information, the Board of Commissioners may:

1. Adopt the proposed amendment.
2. Adopt the proposed amendment with modifications.
3. Reject the proposed amendment.
4. Refer the proposed amendment back to the Planning Board for further consideration.

15.17.5. Waiting Period For Subsequent Applications

A. After an application for an amendment has been approved or denied by the Board of Commissioners, there shall be a 6 month waiting period before an application shall be considered on the same issue

B. This waiting period may be waived by the Board of Commissioners (three-fourths vote required) if it determines that there have been substantial changes in conditions or circumstances which may relate to the request

15.18. ANNEXATION AND EXTRATERRITORIAL JURISDICTION (ETJ) EXPANSION

15.18.1. Annexation Applicability

NCGS allows the Town to extend its corporate boundaries through annexation. annexation may be initiated by the Town or by the owners of the subject property. the

process contained within this ordinance pertains to voluntary annexation, requested by the property owner.

Annexation is required prior to the provision of Town services as well as water and sewer services. Annexation does not guarantee the availability of such services. annexation is required prior to construction plan approval for those developments requesting Town services and water and sewer service. annexation is required before or concurrent with rezoning and development applications for property within the Town's urban service areas or annexation agreement areas.

15.18.2. Annexation Petition Procedures

A. **Process**: Legislative

B. **Applicants**: Voluntary annexation petitions may only be submitted by the property owner(s).

C. **Content of Application**: See annexation checklist.

D. **Determination of Compliance**: The Board of Commissioners shall direct the Town Clerk to investigate the annexation petition, and upon finding it sufficient, to certify the sufficiency of the annexation petition. the sufficiency of the annexation petition shall be in accordance with the statutory requirements. the Board of Commissioners shall set the date for the public hearing. after certifying the sufficiency, the Administrator shall prepare a staff report and recommendation on this matter.

E. **Public Notification**: Shall be conducted in accordance with NCGS

F. **Public Hearing**: Shall be conducted in accordance with NCGS.

G. **Board of Commissioners Decision:** Following a legislative public hearing, the Board of Commissioners shall take one of the following actions:

1. Approve the annexation request.
2. Table the annexation request pending the submittal of additional information.
3. Deny the annexation request.

15.18.3. Effect of Annexation

A. **Effectiveness:** The subject property shall be considered annexed effective the date listed in the adopted ordinance approving the annexation. Once annexed, the area and its owners and occupants are subject to the same debts, laws, ordinances, and regulations and are entitled to the same privileges and benefits as other parts of the town. .

B. **Notification:** The adopted ordinance along with the legal description and property map shall be recorded with the Register of Deeds and filed with the Secretary of State.

15.18.4. Extraterriortorial Jurisdiction Expansion

NCGS 160D allows the Town to extend the boundaries of the ETJ area. The notification period and process, including for any associated rezoning, and boundary amendment procedures outlined in NCGS 160D shall be followed.

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1 WATER & SEWER DESIGN

(last revised 3/09/15)

1.1 WAKE FOREST & CITY OF RALEIGH MERGER

In July 2005 the Town of Wake Forest and the City of Raleigh merged their water and sewer systems. As a result of the merger, the City of Raleigh owns and operates the water and wastewater system that provides service to residents within the urban service area designated for the Town of Wake Forest. However, the Town has authority concerning when and where new water and sewer services can be extended to support growth and development within its planning and zoning jurisdiction, subject to conditions in the inter-local agreement.

In accordance with the regional utility plan, the City of Raleigh assumed sole responsibility for operating, maintaining, improving and expanding the water and wastewater collection system that serves the Town of Wake Forest. Since the merger, the two municipalities have worked together to refine a schedule of upgrades and improvements to Wake Forest's water and sewer system.

Thus, all water and sewer infrastructure within the jurisdiction of the Town of Wake Forest shall conform to the requirements of the City of Raleigh Public Utilities Department. Refer to the City of Raleigh Public Utilities Handbook, available online at:

http://www.raleighnc.gov/home/content/Departments/Articles/PublicUtilities.html

2 STORMWATER MANAGEMENT

(last revised 3/09/15)

2.1 INTRODUCTION

A. The following section has been established to assist developers and engineers with the design, construction and maintenance of stormwater (private and public) infrastructure within the jurisdiction of the Town of Wake Forest. The methods, procedures, design factors, formulas, graphs, and tables presented in this section are intended to establish minimal guidelines for residential, commercial and industrial storm drainage design, and for the solution of drainage problems involving determinations of the quantity of runoff, rate of flow, method of collection, storage, and conveyance of storm water. The Town of Wake Forest believes that the following criteria are sufficient to ensure the welfare and safety of the general public and to protect the economic investment of the citizens of our Town.

B. Alternative design methods may be considered by the Engineer/Designer on a case-by-case basis; however, there should not be extensive variations from the criteria and procedures within this division without the expressed approval of the Town's Engineer.

2.1.1 TOWN ENGINEER

The Town Engineer shall be responsible for interpretation and implementation of the stormwater management and design criteria for the Town of Wake Forest. Approval from other applicable agencies may be required.

2.1.2 STORM DRAINAGE POLICY

It is the policy of the Town of Wake Forest that all developed land within the Town jurisdiction have adequate stormwater facilities and controls to protect, maintain and enhance the public health, safety, environment and general welfare in order to control the adverse effects of increased post-development stormwater runoff and nonpoint and point source pollution associated with new development and redevelopment.

The Town may accept stormwater management systems for maintenance if the system provides drainage for streets that have been accepted for maintenance by the Town Board and have been designed and constructed in accordance with the provisions of this manual, the Unified Development Ordinance. The latest revision to the following documents which are herein made part of this manual by reference:

- North Carolina Erosion and Sediment Control Planning and Design Manual http://portal.ncdenr.org/web/lr/publications
- NCDENR Stormwater Best Management Practices Manual http://portal.ncdenr.org/web/lr/bmp-manual

2.1.3 ACKNOWLEDGEMENTS

This division has been prepared by Appian Consulting Engineers, P.A. of Rocky Mount, North Carolina, in cooperation with the Town of Wake Forest, North Carolina. Appian has collected design data from over 10 drainage criteria manuals from throughout the United States. Those manuals were available for use in preparing this division. However, the content of this division is largely derived from the *Drainage Criteria Manual for Montgomery County, Texas*, [Dodson, 1989], and *Elements of Urban Stormwater Design*, [H. Rooney Malcom, P.E., 1989]. These manuals were particularly important because of their format, quality, completeness, and because they represented accepted criteria applied in the area of the Town of Wake Forest.

2.1.4 DISCLAIMER

To the best of their ability, the authors of this manual ensured that the material is accurate and reliable for use by others in the development of stormwater management plans and calculations. It is the final responsibility of the design professional to ensure that any methods, procedures and techniques specified in this manual are appropriate for a given situation. The Town of Wake Forest does not accept responsibility for any cost, loss, damage or injury resulting from the use of this manual.

2.2 STORMWATER MANAGEMENT REVIEW

A **Stormwater Management Permit** is required for all new development and redevelopment within the Town of Wake Forest jurisdiction, including, but not limited to site plan applications, subdivision applications and grading application, unless exempt per Section 2.2.1. The Town of Wake Forest is a Phase II community, and implements post-construction stormwater management in new development and redevelopment in accordance with the Clean Water Act and Phase II Stormwater Rules. The US Environmental Protection Agency designated the Town for inclusion in the Phase II Stormwater Program because its municipal boundary intersects a US Census-defined Urbanized area.

2.2.1 EXEMPTIONS

As noted in the Town of Wake Forest Unified Development Ordinance Section 12.5.1, the following types of development and redevelopment shall be **exempt** from the provisions of this ordinance, provided that they are not in the Falls Lake Watershed and are not part of a large plan of common development or sale:

A. Development or redevelopment that cumulatively disturbs less than 1 acre;

B. All development or redevelopment in the RA-HC and UMX Districts;

C. Redevelopment in all districts with no increase in impervious coverage;

D. All development or redevelopment of State or Federally owned properties.

2.2.2 WHEN A PERMIT IS REQUIRED

Unless excluded by Section 2.2.1, a stormwater management plan and permit is required for land disturbance as follows:

Table 2.1

Type of Development	Phase II Rules	Falls Lake Watershed
Single-family, detached and duplex residential	1.0 ac or greater	0.50 ac or greater
Multi-family residential, commercial & industrial	1.0 ac or greater	12,000 sf or greater
Refer to Section:	Section 2.3.1	Section 2.3.2

2.2.3 NEUSE RIVER BASIN RIPARIAN BUFFER PROTECTION

All development and redevelopment within the Town jurisdiction shall comply with the standards of the Neuse River Basin: Nutrient Sensitive Waters Management Strategy: Protection and Maintenance of Riparian Areas with Existing Forest Vegetation (15A NCAC 2B.0233), as amended, and the Town of Wake Forest Unified Development Ordinance, Section 12.7.2, "Watercourse Buffer Tables." Any encroachment within a Neuse River riparian buffer, wetland or stream is subject to NCDENR approval. Additional information about the Neuse Nutrient Strategy may be obtained at:
http://portal.ncdenr.org/web/wq/ps/nps/neuse.

2.2.4 FALL LAKE WATERSHED STANDARDS

Part of the Town is located within the Falls Lake Watershed of the Neuse River Basin. New development within the Falls Lake Watershed must also comply with the Falls Lake Nutrient Strategy (15A NCAC 2B .0275-.0282), discussed in Section 2.3.2. Additional information may be obtained at:

http://portal.ncdenr.org/web/fallslake

2.2.5 STORMWATER MANAGEMENT PERMIT APPLICATION

The Stormwater Management Permit application package should be inclusive of all necessary materials to understand the design and how the site will be developed in relation to stormwater management. Refer also to Section 6.6, which details plan and submittal requirements.

A. Stormwater Permit Application: Applicants are to submit the latest "State Stormwater Permit Application" forms (including Low Density Supplement Form, if applicable) from NCDENR: http://portal.ncdenr.org/web/lr/state-stormwater-forms_docs

B. **Stormwater Management Checklist:** The application must be submitted with the items as detailed in the Stormwater Management Checklist, *Form SW100*, found in Section 2.12 of this manual and online at: http://www.wakeforestnc.gov.

C. Additional checklists and worksheets are included in the NC Department of Environment and Natural Resources (NCDENR) Stormwater Best Management Practices Manual, latest revision, available online at: http://portal.ncdenr.org/web/lr/bmp-manual.

2.2.6 CALCULATION REQUIREMENTS

All storm water calculations (runoff, pipe, ditch and inlet sizing and detention routing (if required) shall be submitted with the plans.

A. Calculations shall consider inlet and outlet control, hydraulic grade line and backwater as applicable.

B. The calculation package shall identify the project name and location, name of designer, and shall bear the designer's seal, date and signature.

C. All detention/retention facilities in the jurisdiction of Town of Wake Forest shall be designed to attenuate developed condition peak discharges to the existing conditions for the given storm calculation. See Section 2.8.

D. All BMPs shall be designed according to the NCDENR Stormwater Best Management Practices Manual, with NCDENR supplement forms submitted in the calculation package. See Section 2.8.

2.2.7 PLAN REQUIREMENTS

A. Tributary Areas: Tributary area plans (runoff map) must be included to justify discharges in all cases. Plans shall either show storm drainage calculations or the calculations shall be submitted in a separate package as noted above in Section 2.2.6 above.

B. Plan Submittals: Profiles and cross-sections for existing and proposed drainage courses may be required at the discretion of the Town's Engineer. When required, plans shall include street and/or off-street profiles of drainage ditches/pipe systems included for public maintenance. Profiles shall be same scale as plan view and shall show any water or sewer crossings or parallel lines.

2.3 PHASE II & WATERSHED PROTECTION REQUIREMENTS

Where a stormwater permit is required for projects within the jurisdiction of the Town, projects shall comply with the Phase II program requirements (Section 2.3.1), the supplemental Falls Lake Rules (Section 2.3.2), and Richland Creek and Smith Creek Water Supply Watershed requirements (Section 2.3.3).

2.3.1 PHASE II REQUIREMENTS: LOW OR HIGH DENSITY OPTION

In accordance with the Phase II rules all development and redevelopment shall be permitted as either a Low Density or High Density Project. **Note that nutrient calculations are <u>not</u> required unless the project is within the Falls Lake Watershed.**

Table 2.2

Stormwater Permit Option	Summary of Requirements
Low Density	• 24% or less BUA • Vegetated conveyances (no stormwater collection system)
High Density	• Greater than 24% BUA • 70% BUA max • 85% TSS removal • Post = Pre for 1-year, 24-hour storm

A. Low Density projects shall include those developments that have a maximum of 24% built upon area for all residential and non-residential development; and

1. A maximum density of two (2) dwelling units per acre for single family detached development; OR
2. A minimum lot size of 20,000 square feet for single family detached development (excluding roadway right-of-way).
3. Total project area shall include total acreage in the tract on which the project is to be developed.
4. Low density projects shall comply with each of the following standards:
   a. **Vegetated Conveyances:** Stormwater runoff shall be transported by vegetated conveyances to the maximum extent practicable.
   b. **Watercourse Buffers (Minimum Each Side):** See Section 12.7 of the Unified Development Ordinance.

B. High Density projects shall include those developments with greater than 24% built upon area for all residential and non-residential development.

1. New residential and non-residential development shall not exceed seventy percent (70%) impervious surface.
2. For the purpose of calculating the impervious surface area, total project area shall include total acreage in the tract on which the project is to be developed.
3. High density projects shall comply with each of the following standards:
   a. **Runoff Volume:** Stormwater control measures shall control and treat the difference in stormwater runoff volume leaving the project between the pre- and post-development conditions for, at a minimum, the *1-year, 24-hour storm*. Runoff volume drawdown time shall be a minimum of 48 hours, but not more than 120 hours.

b. **Total Suspended Solids (TSS):** All structural stormwater treatment systems used to meet the requirements of the program shall be designed to have a minimum of 85% average annual removal for Total Suspended Solids.

c. **Design Criteria:** General engineering design criteria for all projects shall be in accordance with 15A NCAC 2H .1008(c), as explained in the NCDENR Stormwater Best Management Practices Manual, available online at: http://portal.ncdenr.org/web/lr/bmp-manual

d. **Watercourse Buffers (Minimum Each Side):** See Section 12.7 of the Unified Development Ordinance.

2.3.2 FALLS LAKE WATERSHED REQUIREMENTS

In addition to the Low-Density or High-Density requirements described in Section 2.3.1, all development within the Falls Lake Watershed must comply with the Falls Lake Nutrient Strategy (15A NCAC 2B .0275-.0282), with requirements described below. Additional information may be obtained at: http://portal.ncdenr.org/web/fallslake.

A. Nitrogen and Phosphorus Loading

1. Nitrogen and phosphorus loads contributed by the proposed new development shall not exceed the following unit-area mass loading rates: 2.2 and 0.33 pounds per acre per year for nitrogen and phosphorus, respectively.

Table 2.3

	Falls Lake Watershed Maximum Limit (lbs/ac/year)
Nitrogen	2.2
Phosphorus	0.33

2. **Falls Nutrient Loading Accounting Tool:** Calculations within the Falls Lake Watershed are to follow the model and worksheets described provided by NCDENR with the nutrient loading limits described above. The developer shall determine the need for engineered stormwater controls to meet these loading rate targets by using the approved accounting tool. The Falls Lake Nutrient Loading Accounting Tool can be found online at: http://portal.ncdenr.org/web/fallslake/rules-implementation-information.

3. **Redevelopment Option:** Notwithstanding 15A NCAC 2B.104(q), redevelopment that would replace or expand existing structures or improvements and would result in a net increase in built-upon area shall have the option of either meeting the nutrient loading standards identified above OR meeting a loading rate that achieves the following nutrient loads compared to the existing development: 40% and 77% reduction for nitrogen and phosphorus, respectively.

B. Nitrogen and Phosphorus Standard is Supplemental: The nitrogen and phosphorus loading standards in this section are supplemental to, not replacements for, stormwater standards otherwise required by federal, state or local law, including without limitation any riparian buffer requirements applicable to the location of the development, 15A NCAC 2B .0223 and .0242.

C. Control and Treatment of Runoff Volume: Stormwater systems shall be designed to control and treat the runoff generated from all surfaces by one inch of rainfall.

1. The treatment volume shall be drawn down pursuant to standards specific to each practice as provided in the NCDENR Stormwater Best Management Practices Manual.
2. To ensure that the integrity and nutrient processing functions of receiving waters and associated riparian buffers are not compromised by erosive flows, stormwater flows from the development shall not contribute to degradation of waters of the State.
3. At a minimum, the development shall not result in a net increase in peak flow leaving the site from pre-development conditions for the 1-year, 24-hour storm event.

D. Partial Offset of Nutrient Control Requirements: Development subject to this ordinance shall attain nitrogen and phosphorus loading rate reductions on-site that meet the following criteria prior to using an offsite offset measure:

1. 30% or more reduction in both nitrogen and phosphorus loading from the untreated conditions for any single-family, detached and duplex residential development disturbing ½ acre but less than 1 acre.
2. 50% or more reduction in both nitrogen and phosphorus loading from the untreated conditions for any single-family, detached and duplex residential development disturbing more than 1 acre.
3. 30% or more reduction in both nitrogen and phosphorus loading from the untreated condition for other development, including multi-family residential, commercial and industrial development disturbing 12,000 square feet but less than 1 acre.
4. 50% or more reduction in both nitrogen and phosphorus loading from the untreated condition for other development, including multi-family residential, commercial and industrial development disturbing more than 1 acre.

Table 2.4

Type of Development	*Area Disturbed*	*Minimum Reduction in N&P from Untreated Conditions*
Single-family, detached and duplex residential	0.50 ac to 0.99 ac	30%
	1.0 ac or more	50%
Other development, including multi-family residential, commercial and industrial development	12,000 sf to 0.99 ac	30%
	1.0 ac or more	50%

E. Nutrient Offset Payments: A developer subject to the Falls Lake nutrient requirements can offset nutrient loading on site or choose a third-party mitigation provider such as the NC Ecosystem Enhancement Program (NCEEP) or a compensatory mitigation bank to "buy down" their loading requirements to meet the thresholds established for nutrient loading. A Developer is required to purchase credits from a **private mitigation bank** unless:

1. There are no listed mitigation banks with nutrient credits located in the hydrologic unit where this impact will take place; see NCDENR link below: http://portal.ncdenr.org/c/document_library/get_file?uuid=0bd3ee09-a658-468f-bc10-e3a897636ee8&groupId=38364
   OR

2. The applicant is a Federal or State Government Entity or a unit of local government meeting the requirements set forth in G.S. 143-214.11 (as amended by SL 2011-343) and is not required to purchase credits from a mitigation bank; OR
3. There are no credits available from the mitigation bank(s) in the hydrologic unit where the impacts will occur; OR
4. The use of a mitigation bank was not approved to provide the required mitigation for this project (written confirmation from permitting agency required).

F. NC Ecosystem Enhancement Program's Nutrient Offset Program:
The NC Ecosystem Enhancement Program's Nutrient Offset Program (NCEEP) was developed to provide a mechanism to assist developers in meeting their nutrient loading requirements. The NCEEP partners with private biological-engineering and mitigation contractors on wetlands restoration and enhancement programs across the state. NCEEP accepts "buy down" payments from permit holders in lieu of actual undertaking of a mitigation project. NCEEP then uses the money to create, restore or enhance wetlands, streams and riparian areas. Refer to:
http://portal.ncdenr.org/web/eep/nutrient-offset-request-process

Questions regarding process may be addressed to:
Kelly Williams
NCEEP In-Lieu Fee Program Coordinator
919.707.8915/kelly.williams@ncdenr.gov

2.3.3 WATER SUPPLY WATERSHED REQUIREMENTS

Development and redevelopment within the Richland Creek (WS-IV) and Smith Creek (WS-II) Water Supply Watersheds shall comply with the requirements prescribed by NCDENR and the Town of Wake Forest Unified Development Ordinance, Section 12.6. See Table 2.5 below.

Impervious Surface Averaging for two noncontinguous parcels shall be allowable as described in the Town of Wake Forest Unified Development Ordinance, Section 12.6.2

Table 2.5

1. Falls Lake Water Supply Watershed (Class WS-IV)

Development Type	Location Classification	Maximum Density	Maximum Impervious Surface Coverage
Single Family Residential Development	Critical Area (FL-CA)	1 unit/ 2 acres	6%
	Watershed Management Area (FL-WMA)	1 unit/ acre	12% w/o municipal water & sewer OR 24% with municipal water & sewer
All Other Development	Critical Area (FL-CA)	Follows base zoning	6%
	Watershed Management Area (FL-WMA)	Follows base zoning	12% w/o municipal water & sewer (Low Density Option); 24% with municipal water & sewer (Low Density Option); OR 70% (High Density Option)*

2. Richland Creek Water Supply Watershed (Class WS-IV)

Development Type	Location Classification	Maximum Density	Maximum Impervious Surface Coverage
Single Family Residential Development	Critical Area (RC-CA)	2 units/acre	24% (Low Density Option)
		Follows base zoning	50% (High Density Option)*
	Watershed Management Area (RC-WMA)	Follows base zoning	70% (High Density Option)*
All Other Development	Critical Area (RC-CA)	Follows base zoning	24% (Low Density Option)
			50% (High Density Option)*
	Watershed Management Area (RC-WMA)	Follows base zoning	70% (High Density Option)*

3. Smith Creek Water Supply Watershed (Class WS-II)

Development Type	Location Classification	Maximum Density	Maximum Impervious Surface Coverage
Single Family Residential Development	Critical Area (SC-CA)	1 unit/ 2 acres	6%
		1 unit/ 2 acres	24% (High Density Option)*
	Watershed Management Area (SC-WMA)	1 unit/ acre	12% (Low Density Option) 30% (High Density Option)*
All Other Development	Critical Area (SC-CA)	Follows base zoning	6%
			24% (High Density Option)*
	Watershed Management Area (SC-WMA)	Follows base zoning	12% (Low Density Option) 30% (High Density Option)*

* All high impervious surface options require municipal water and sewer service

2.4 STORM DRAINAGE DESIGN

The purpose of this section is to provide a guide for the design of storm drainage systems and structures within the jurisdiction of the Town of Wake Forest.

2.4.1 MINIMUM DESIGN STANDARDS

All storm drainage systems within the jurisdiction of the Town of Wake Forest shall meet all the requirements of the Town of Wake Forest Manual of Specifications, Standards and Design, latest revision. The following shall be considered to be the minimum standards of design for storm drainage systems within the jurisdiction of the Town of Wake Forest.

2.4.2 GENERAL

The design of storm drainage infrastructure within the jurisdiction of the Town of Wake Forest shall be in accordance with the Technical Specifications. The subdivision/ development shall provide an adequate drainage system, including necessary open ditches, pipe culverts, drop inlets, bridges, fill-in lots, etc. for the proper drainage of all surface water. The subdivider/developer shall connect to the Wake Forest storm drainage system where available; if not accessible, the subdivider/developer shall provide open drainage ditches necessary to carry the water in a manner approved by the Town's Engineer. The minimum standards of design shall adhere to the following guidelines.

2.4.3 POTENTIAL FLOOD HAZARDS

All subdivisions/development proposals shall be consistent with the need to minimize flood damage. All subdivision/development proposals shall have public utilities and facilities (such as sewer, gas, electrical and water systems) located and constructed to minimize flood damage. All subdivisions/developments shall have adequate drainage provided to reduce exposure to flood hazards.

A. Evaluation of Downstream Impacts: Unless specifically exempted by the Town's Engineer, all new development shall evaluate the stormwater impacts, created by their project, to off-site existing stormwater systems that receive runoff from the new development. These off-site systems may be open ditches, streams or pipe.

1. The limits of the analysis shall be 500 feet downstream and to a point where the proposed development is 10% of the total watershed.
2. Analysis shall also be conducted upstream to ensure the proposed development does not use up all the existing capacity of the off-site system.
3. If the existing stormwater system(s) cannot handle the runoff from the proposed development, the development shall either:
    a. Install on site stormwater controls (BMP's) to reduce the peak flow; or
    b. Upgrade the existing stormwater system to handle the increased flow.
4. All engineered stormwater solutions shall be evaluated by the Town's Engineer to determine whether the improvements meet the Town requirements.

2.4.4 DESIGN STORM FREQUENCY

All drainage systems components within the Town of Wake Forest's jurisdiction shall be designed to accommodate the frequency storm per Table 2.6:

Table 2.6 Design and Check Storms

Arterial Roadways	25-year	100-year
Collector streets	25-year	100-year
Local Roadways	10-year	25-year
Bridges/Box Culverts, Stream Crossings[1]	50-year	100-year
Open channels[2]	25-year	100-year
Cross-drainage	25-year	-
Adjacent to building structures w/ flooding potential	100-year	-
BMP Structures/Non-structures	Per NCDENR BMP Design Manual	
Drainage facilities for residential development accepting lot runoff only (no roadway discharge)	2-year	10-year
Drainage Facilities providing diffuse flow	10-year	25-year
Drainage Facilities for Parking Lot	10-year	25-year
Spillway structure for impoundment (i.e. detention/retention facilities)	25-year	100-year
Curb & gutters, curb & gutter inlets	2-year, 5 minute TC	-

[1] For regulatory Floodways, the Design Storm is the 100-year return period
[2]See also section 2.6.1

2.4.5 DESIGN METHOD FOR COMPUTING RUNOFF

Storm water runoff calculations shall be computed by the following methods based on the watershed under study:

Table 2.7

Watershed	Method
Less than 50 acres	Rational Method
50 to 640 Acres	SCS and Malcom Method
Larger than 640 Acres with multiple sub-areas	HEC 1

2.4.6 DRAINAGE DESIGN CONSTRAINTS

A. Velocity: Velocity of drainage flow after development shall not exceed that before development upon leaving the development.

B. Erosion Control: The Town of Wake Forest has been delegated as an authority to review and approve erosion control plans by the State. All erosion control plans must be submitted to the Town of Wake Forest for review and approval. Erosion control measures shall be in accordance with the North Carolina Erosion Control Manual, latest revision.

C. Buffer Strip along natural drainage ways: All Neuse River Buffer rules must be followed.

D. Roadside ditch liners: In all subdivisions where there is no curb and gutter, side ditches requiring protection shall be concrete paved. Riprap may be accepted upon approval of Town of Wake Forest Engineering staff. See Table 2.19.

E. Drainage along subdivision side lot lines: Storm drainage systems shall follow the natural contour of the subdivision lots.

F. Standard improved ditch cross-section: All improved ditches shall have:

1. A minimum 3-foot bottom width,

2. A maximum side slope of 3:1.
3. A minimum longitudinal grade of 0.3%.

G. **Rip Rap Filter**: Geotextile fabric will be required under all riprap. Fabric shall meet the requirements of Specification Section 02210, paragraph 2.2.1 Geotextile Fabric. Filter stone may not be used in lieu of fabric.

H. **Limits of Public Ownership and Maintenance Responsibility**

1. All drainage easements shall be public to the end of any storm drainage pipe system stilling basin. **All drainage beyond that point shall be carried in drainage easements which are private and will be owned and maintained by the individual property Owner**.
2. **The Town of Wake Forest assumes no liability or responsibility for adjudicating disputes between property owners regarding non-publicly generated storm water**.
3. **Drainage easements and dedications**: This shall apply both inside the corporate limits and the ETJ as well as in any development receiving Town water and /or sewer service by contract.

   Where a subdivision/development is traversed by a water course, drainage way, underground storm drain, the subdivider/developer shall dedicate to the Town (where applicable in accordance with the above) a drainage maintenance easement as specified by Section 6.10.1 of the Town of Wake Forest Unified Development Ordinance. Private drainage easement widths shall also correspond to these same criteria. The Town's Engineer may require wider easement widths if the topography along the proposed right-of-way is such that maintenance equipment cannot reasonably operated within the easement.

I. **Pipe Material**: All storm drainage pipes shall be reinforced concrete class III minimum B or C Wall. Pipe systems greater than 72-inches in diameter will be reviewed on a case-by-case basis for material and construction.

J. **Manhole rings and covers**: All storm sewer manhole rings and covers shall be sanitary sewer standard, except that they shall be stamped "storm sewer."

K. **Street Pipe Culverts**: Culverts shall be provided to accommodate all natural water flow and shall be of sufficient length to permit full width roadway construction with the required slopes (fill or cut). The pipe shall be designed in accordance with the Stormwater Management and Design Criteria in this chapter. Cross drains shall be built on straight line and grade and shall be laid with the ends filled and matched to provide joints in conformity with Section 2.4.9.L with a smooth invert. They shall be placed at sufficient depth below the roadbed to avoid the dangerous pressure of impact. See Standard Detail 9.53 for installation type, bedding and cover requirements for rigid pipe. However, in a case where the pipe is not more than 12-inches below the roadbed, the pipe shall be reinforced with concrete. The minimum diameter is 15 inches (See Section 2.10).

L. **Open Joints in Drainage Pipe**: Where it is deemed necessary by the Town's Engineer, the joint in the bottom 2-inches (of the pipe diameter) shall be left open to permit groundwater infiltration into the pipe system. The pipe shall have bedding conforming to Standard Detail 9.53 as well as Technical Specification Section 02700 paragraph 3.3.B Bedding Rigid Pipe.

M. **Road/Street Foundation Subdrain/Underdrain**: A subdrain will be required in all cases where high water tables may cause problems with subgrade. Parallel or herringbone systems will be used as appropriate.

N. Precast Catch Basins: Precast catch basins with weep holes shall generally be required. See standard Details 9.50 through 9.61 as applicable.

O. Flared End Sections: Flared end sections will be permitted on pipe as follows:

1. On single pipe systems up to a 42" diameter

2. On twin pipe systems up to 18" diameter.

Otherwise, head walls will be used for all larger pipe systems and for all other multi-barrel pipe systems.

P. Head/End walls: For Head/End wall construction details, refer to the NCDOT Highway Design Branch Roadway Standard Drawings, latest revision. Standard Drawings are to be used *in conjunction* with the NCDOT Standard Specifications unless otherwise more restrictive as specified in this manual.

Q. Combined Sewer Flow: No storm water drainage shall be discharged into a sanitary sewer.

2.5 HYDROLOGIC ANALYSIS: DETERMINATION OF RUNOFF

The purpose of this section is to establish standard procedures and criteria for the performance of hydrologic analyses in the Town of Wake Forest.

2.5.1 DETERMINATION OF RUNOFF

A. The determination of runoff may be the single most important factor in the planning, design, and construction of drainage facilities. If the estimate of storm runoff is incorrect, the constructed facilities may be undersized or oversized. An improperly designed drainage system may be uneconomical, cause flooding, interfere with traffic, and may be a general nuisance in the affected area. However, determination of runoff can only be approximated using sound engineering processes to represent physical and climatic factors to best model the system.

B. There are many methods currently available to estimate peak flow rates. The Town of Wake Forest will use the Rational Method for watersheds smaller than 50 acres, the SCS and the Malcom Method to develop runoff hydrographs for watersheds greater or equal to 50 acres and less than 640 acres, and HEC 1 for watersheds greater than 640 acres and for watersheds with multiple sub-areas.

2.5.2 WATERSHEDS SMALLER THAN 50 ACRES: RATIONAL METHOD

For small drainage areas (less than 50 acres in size), the widely used Rational Method provides a useful means of determining peak discharges. The Rational Method represents an accepted method for determining peak storm runoff rates for small watersheds that have a drainage system unaffected by complex hydrologic situations such as ponding areas and storage basins.

A. It is generally recommended that in the Town of Wake Forest that Rational Method be used for areas of less than 50 acres.

B. In situations requiring determination of a complete flood hydrograph, and not just a peak discharge, a method developed by H.R. Malcom [Malcom, Updated] should be utilized. Engineers wishing to use an alternative design technique should consult the Town's Engineer prior to design.

C. Rainfall Intensity: Point precipitation estimates shown in Table 2.8 for the Town of Wake Forest were obtained from NOAA's National Weather Service Hydrometerological Design Studies Center and are based on the latest rainfall data as of this printing. Since rainfall estimates are based on continuously changing

statistical data, the designer is encouraged to verify the latest rainfall data from NOAA's National Weather Service Hydrometerological Design Studies Center online at: http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=nc.

2.5.3 WATERSHEDS FROM 50 TO 640 ACRES: SCS AND MALCOM'S METHOD

A. Hydrological analyses involving watersheds of greater than or equal to 50 acres and less than 640 acres may be completed using the SCS and Malcom Method to develop runoff hydrographs.

B. Malcom's Method for hydrograph development is useful in the design of facilities which require an analysis over time. This procedure can be used in conjunction with the Soil Conservation Service (SCS) Method or the Rational Method. This methodology utilizes a pattern hydrograph to obtain a curvilinear design hydrograph which peaks at the design flow rate and which contains a runoff volume consistent with the design rainfall. The pattern hydrograph is a step function approximation to the dimensionless hydrograph proposed by the Bureau of Reclamation and the Soil Conservation Service [SCS, 1972].

C. This method is commonly used in designs that require storage areas, detention/retention basin design, ponding areas, or simply when a system needs to be routed in order to determine a peak elevation for any given storm event.

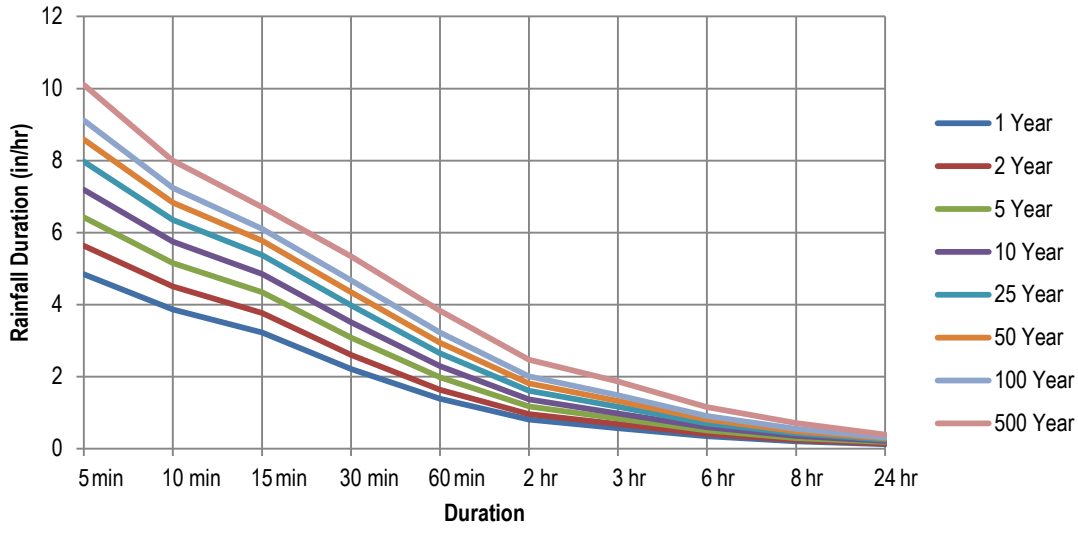
2.5.4 WATERSHEDS LARGER THAN 640 ACRES

For areas less than 2,000 acres, the SCS Tabular or Synthetic Hydrograph or Snyder's Synthetic Unit Hydrograph (Hydrain includes this design alternate. See HEC 19 [archived] for detailed direction in this procedure.) method may be used for determining volume of flow and peak discharge. HEC 1 may also be used for basin areas larger than 640 acres (1 sq. mi.). Hydrograph methods can be computationally involved so computer programs such as HEC 1, TR-20, TR-55, and HYDRAIN may be utilized.

2.5.5 DESIGN AIDS

The following tables and figures provide information for stormwater management design.

Figure 2.1
I-D-F Curve
Town of Wake Forest



Source: Point Precipitation Frequency Estimates from NOAA Atlas 14, Vol. 2, Ver. 3
Wake Forest, North Carolina, 35.9768, -78.5108

Table 2.8 Rainfall Intensity-Duration-Frequency Table for the Town of Wake Forest

	Return Period →							
Duration	**1 year (in/hr)**	**2 year (in/hr)**	**5 year (in/hr)**	**10 year (in/hr)**	**25 year (in/hr)**	**50 year (in/hr)**	**100 year (in/hr)**	**500 year (in/hr)**
5 minute	4.84	5.63	6.42	7.19	7.97	8.58	9.12	10.1
10 minute	3.86	4.50	5.15	5.75	6.35	6.83	7.24	8.00
15 minute	3.22	3.77	4.34	4.85	5.37	5.77	6.10	6.71
30 minute	2.21	2.60	3.08	3.51	3.98	4.34	4.67	5.34
60 minute	1.38	1.63	1.98	2.29	2.65	2.94	3.22	3.83
2 hour	0.804	0.958	1.17	1.37	1.61	1.81	2.01	2.47
3 hour	0.568	0.678	0.831	0.979	1.16	1.32	1.48	1.86
6 hour	0.342	0.408	0.501	0.591	0.703	0.803	0.902	1.15
12 hour	0.201	0.239	0.295	0.350	0.420	0.482	0.546	0.707
24 hour	0.119	0.144	0.180	0.209	0.248	0.279	0.310	0.387

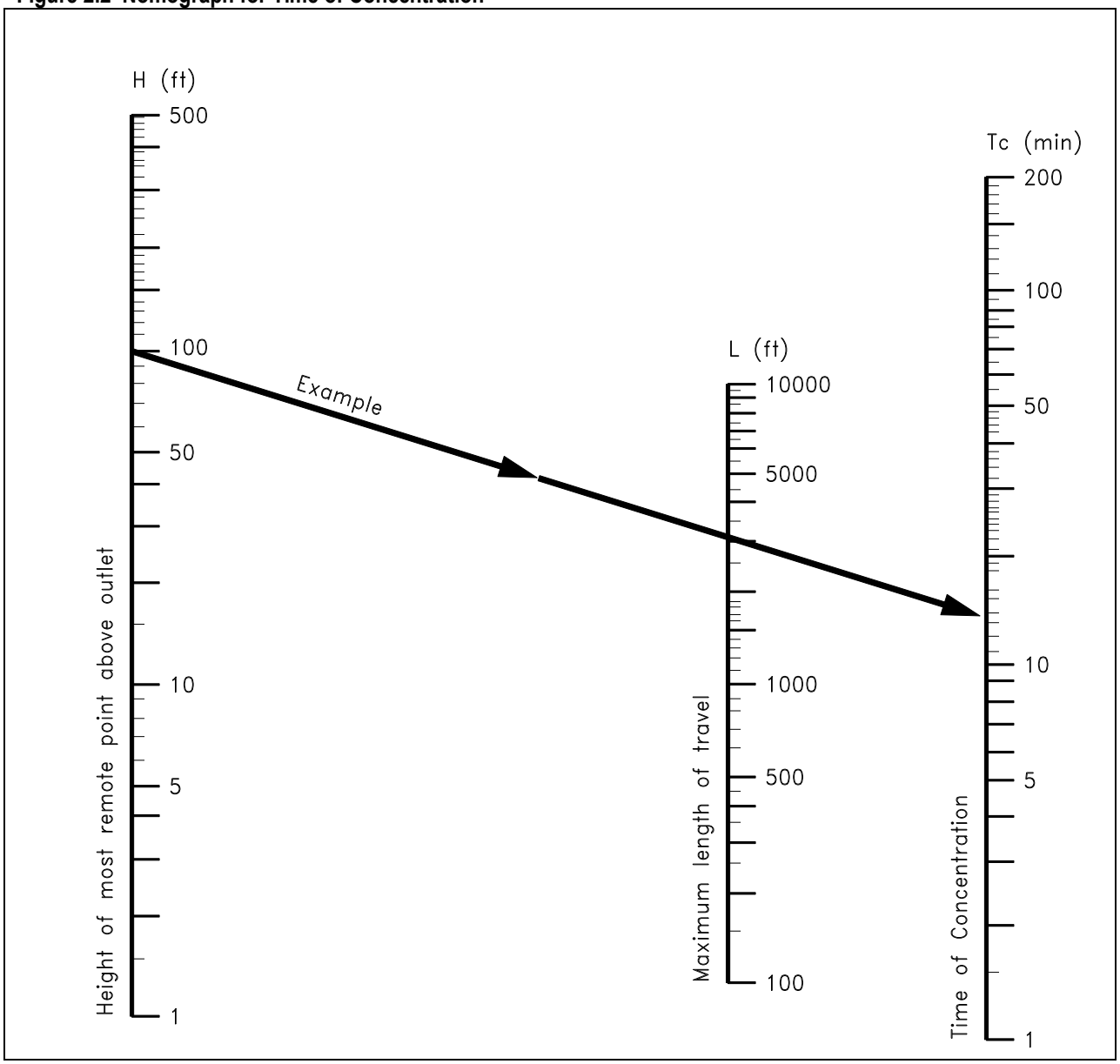
Point Precipitation Frequency Estimates from NOAA Atlas 14, Vol. 2, Ver. 3
Wake Forest, North Carolina, 35.9768, -78.5108

Table 2.9 Depth-Duration-Frequency Table for the Town of Wake Forest

	Return Period →							
Duration	**1 year (in)**	**2 year (in)**	**5 year (in)**	**10 year (in)**	**25 year (in)**	**50 year (in)**	**100 year (in)**	**500 year (in)**
5 minute	0.403	0.469	0.535	0.599	0.664	0.715	0.760	0.843
10 minute	0.644	0.750	0.858	0.959	1.06	1.14	1.21	1.33
15 minute	0.804	0.942	1.08	1.21	1.34	1.44	1.53	1.68
30 minute	1.10	1.30	1.54	1.76	1.99	2.17	2.34	2.67
60 minute	1.38	1.63	1.98	2.29	2.65	2.94	3.22	3.83
2 hour	1.61	1.92	2.34	2.74	3.21	3.63	4.02	4.93
3 hour	1.71	2.04	2.50	2.94	3.48	3.96	4.43	5.58
6 hour	2.05	2.44	3.00	3.54	4.21	4.81	5.40	6.87
12 hour	2.42	2.88	3.56	4.22	5.06	5.81	6.58	8.52
24 hour	2.86	3.45	4.33	5.02	5.95	6.69	7.44	9.28

Point Precipitation Frequency Estimates from NOAA Atlas 14, Vol. 2, Ver. 3
Wake Forest, North Carolina, 35.9768, -78.5108

Figure 2.2 Nomograph for Time of Concentration



Source: "E & S Control Planning and Design Manual," [DEHNR, May 1994 Revised]

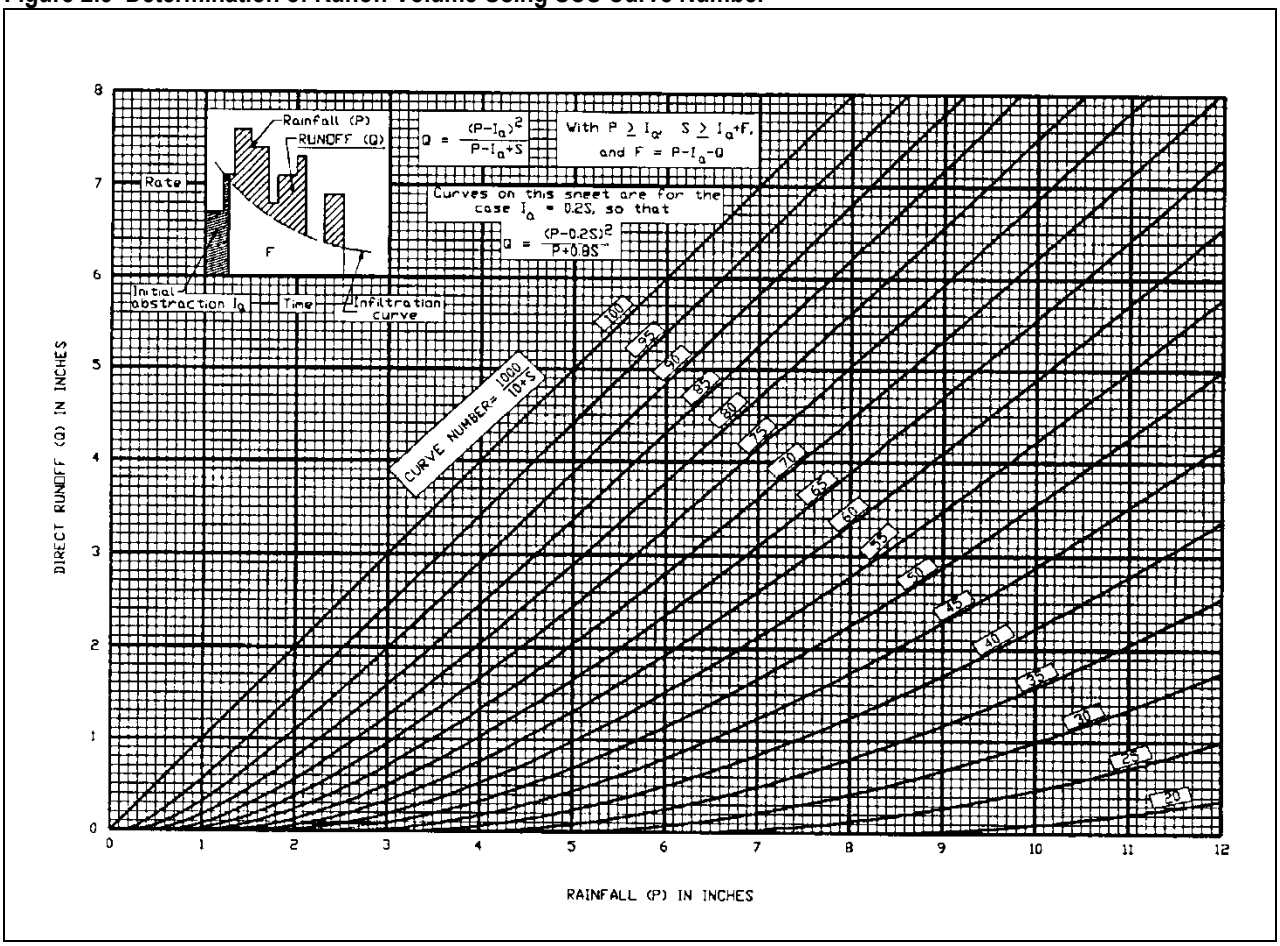
Notes:
1. Use nomograph t_c for natural basins with well-defined channels, for overland flow on bare earth, and for mowed-grass roadside channels.
2. For overland flow, grassed surfaces, multiply t_c by 2.
3. For overland flow, concrete or asphalt surfaces, multiply t_c by 0.4.
4. For concrete channels, multiply t_c by 0.2.

Table 2.10 Rational Method Runoff Coefficients for 5 – 10 Year Frequency Storms

Description of Area	Basin Slope < 1%	Basin Slope 1% - 3.5%	Basin Slope 3.5% - 5.5%
Single Family Residential Districts			
Lots greater than ½ acre	0.30	0.35	0.40
Lots ¼ - ½ acre	0.40	0.45	0.50
Lots less than ¼ acre	0.50	0.55	0.60
Multi-Family Residential Districts	0.60	0.65	0.70
Apartment Dwelling Areas	0.75	0.80	0.85
Business Districts			
Downtown	0.85	0.87	0.90
Neighborhood	0.75	0.80	0.85
Industrial Districts			
Light	0.50	0.65	0.80
Heavy	0.60	0.75	0.90
Railroad Yard Areas	0.20	0.30	0.40
Cemeteries	0.10	0.18	0.25
Playgrounds	0.20	0.28	0.35
Streets			
Asphalt	0.80	0.80	0.80
Concrete	0.85	0.85	0.85
Concrete Drives and Walks	0.85	0.85	0.85
Roofs	0.85	0.85	0.85
Lawn Areas			
Sandy Soil	0.05	0.08	0.12
Clay Soil	0.15	0.18	0.22
Woodlands			
Sandy Soil	0.15	0.18	0.25
Clay Soil	0.18	0.20	0.30
Pasture			
Sandy Soil	0.25	0.35	0.40
Clay Soil	0.30	0.40	0.50
Cultivated			
Sandy Soil	0.30	0.55	0.70
Clay Soil	0.35	0.60	0.80
Bare Soil			
Sandy Soil	0.40	0.50	0.60
Clay Soil	0.60	0.70	0.80
Pond and Lakes	0.98	0.98	0.98

Source: "Drainage Criteria Manual For Montgomery County, Texas," 1989, revised ACE 1998.

Figure 2.3 Determination of Runoff Volume Using SCS Curve Number



Source: "Drainage Criteria Manual for Montgomery County Texas," [Dodson, 1989]

Table 2.11 Values of SCS Curve Number for Urban and Suburban Areas

Land Use Description	Hydrologic Soil Group A	B	C	D
Residential				
1/8 acre or less average lots (65% impervious)	77	85	90	92
1/4 acre average lots (38% impervious)	61	75	83	87
1/3 acre average lots (35% impervious)	57	72	81	86
1/2 acre average lots (25% impervious)	54	70	80	85
1 acre average lots (20% impervious)	51	68	79	84
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and Roads				
Paved with curbs and storm sewers	98	98	98	98
Gravel	76	85	89	91
Dirt	72	82	87	89
Commercial & Business Areas (85% impervious)	89	92	94	95
Industrial Districts (72% Impervious)	81	88	91	93
Open Spaces, Lawns, Parks, Golf Courses, Cemeteries, etc.				
Good condition: grass cover on 75% or more	39	61	74	80
Fair condition: grass cover on 50% to 75%	49	69	79	84
Fallow Straight Row	77	86	91	94
Row Crops				
Straight Row, Poor Condition	72	81	88	91
Straight Row, Good Condition	67	78	85	89
Contoured, Poor Condition	70	79	84	88
Contoured, Good Condition	65	75	82	86
Contoured and Terraced, Poor Condition	66	74	80	82
Contoured and Terraced, Good Condition	62	71	78	81
Small Grain				
Straight Row, Poor Condition	65	76	84	88
Straight Row, Good Condition	63	75	83	87
Contoured, Poor Condition	63	74	82	85
Contoured, Good Condition	61	73	81	84
Contoured and Terraced, Poor Condition	61	72	79	82
Contoured and Terraced, Good Condition	59	70	78	81
Close-Seeded Legumes or Rotation Meadow				
Straight Row, Poor Condition	66	77	85	89
Straight Row, Good Condition	58	72	81	85
Contoured, Poor Condition	64	75	83	85
Contoured, Good Condition	55	69	78	83
Contoured and Terraced, Poor Condition	63	73	80	83
Contoured and Terraced, Good Condition	51	67	76	80
Pasture or Range				
Poor Condition	68	79	86	89
Fair Condition	49	69	79	84
Good Condition	39	61	74	80
Contoured, Poor Condition	47	67	81	88
Contoured, Fair Condition	25	59	75	83
Contoured, Good Condition	6	35	70	79
Meadow, Good Condition	30	58	71	78
Woods or Forest Land				
Poor Condition	45	66	77	83
Fair Condition	36	60	73	79
Good Condition	25	55	70	77
Farmsteads	59	74	82	86

Source: [McCuen, 1982]

2.6 OPEN CHANNEL DESIGN

The purpose of this section is to establish standard procedures and criteria for Open Channel Design for the Town of Wake Forest.

2.6.1 INTRODUCTION

Open channels, where allowed, shall be designed for the peak runoff produced by a 10-year frequency storm where duration equals time of concentration but no less than 5 minutes. Where applicable, an analysis shall also be provided for the 25-year/24 hour frequency storm, i.e. roadway overtopping, and for the 100-year /24 hour frequency storm, i.e. adjacent building structures. The designer's calculations shall include the runoff from the property being developed and the runoff from contributing off-site areas, assuming ultimate development in accordance with the current zoning regulations and the Land Use Plan.

Also see Section 2.6.3.

2.6.2 THE MANNING EQUATION

A. The Manning equation is an empirical relationship which relates friction slope, flow depth, channel roughness, and channel cross-sectional shape to flow rate. The ***friction slope*** is a measure of the rate at which energy is being lost due to channel resistance. When the channel slope and the friction slope are equal ($S_f = S_o$), the flow is uniform and the Manning equation may be used to determine the depth for uniform flow, commonly known as the ***normal depth***.

The Manning equation is as follows:

$$V = \left(\frac{1.49}{n}\right) R^{2/3} \sqrt{S_f} \qquad \textbf{(Equation 2.1)}$$

or

$$Q = \left(\frac{1.49}{n}\right) A R^{2/3} \sqrt{S_f} \qquad \textbf{(Equation 2.2)}$$

Where,

$Q \rightarrow$ Total discharge (cfs)

$V \rightarrow$ Velocity of flow (ft/sec)

$n \rightarrow$ Manning coefficient of roughness (dimensionless), an experimentally determined value which is a function of the nature of the channel lining (Section 2.6.2.B).

$A \rightarrow$ Cross-sectional area of the flow (ft^2)

$R \rightarrow$ Hydraulic radius of the channel (ft) (flow area/wetted perimeter). Wetted perimeter is the distance along the perimeter of the cross section against which water is flowing. It DOES NOT include the free water surface (Section 2.6.3.G).

$S_f \rightarrow$ Friction slope, the rate at which energy is lost due to channel resistance. Longitudinal slope of the water surface (feet fall/feet run). If flow is uniform, it is also the slope of the invert of the channel.

The area (A) and the hydraulic radius (R) are written in terms of the depth (y_o). Knowing the discharge (Q), Manning "n" value, and the channel slope (S_o), Equation 2.20 can be solved by trial to find normal depth (y_o).

B. Manning '*n*' Values

The Manning "n" value is an experimentally derived constant which represents the effect of channel roughness in the Manning equation. Considerable care must be given to the selection of an appropriate "n" value for a given channel due to its significant effect on the results of the Manning equation. Tables 2.12 through 2.16 provide a listing of "n" values for various channel conditions.

Table 2.12 Manning Roughness Coefficient for Excavated or Dredged Channels

Type of Channel and Description	Minimum	Normal	Maximum
Earth, straight and uniform			
Clean, recently completed	0.016	0.018	0.020
Clean, after weathering	0.019	0.022	0.025
Gravel, uniform section, clean	0.022	0.025	0.030
With short grass, few weeds	0.022	0.027	0.033
Earth, winding and sluggish			
No vegetation	0.023	0.025	0.030
Grass, some weeds	0.025	0.030	0.033
Dense weeds or plants in deep channels	0.030	0.035	0.040
Earth bottom and rubble sides	0.028	0.030	0.035
Stony bottom and weedy banks	0.025	0.035	0.040
Cobble bottom and clean sides	0.030	0.040	0.050
Dragline-excavated or dredged			
No vegetation	0.025	0.028	0.033
Light brush or banks	0.035	0.050	0.060
Rock cuts			
Smooth and uniform	0.025	0.035	0.040
Jagged and irregular	0.035	0.040	0.050
Channels not maintained and brush uncut			
Dense weeds, high as flow depth	0.050	0.080	0.012
Clean bottom, brush on sides	0.040	0.050	0.080
Same, highest stage of flow	0.045	0.070	0.110
Dense brush, high stage	0.080	0.100	0.140

Source: [Chow, 1959]

Table 2.13 Manning Roughness Coefficient for Lined or Built-Up Channels

Type of Channel and Description	Minimum	Normal	Maximum
Metal			
Unpainted Smooth steel surface	0.011	0.012	0.014
Painted smooth steel surface	0.012	0.013	0.017
Corrugated metal	0.021	0.025	0.030
Cement			
Neat, surface	0.010	0.011	0.013
Mortar	0.011	0.013	0.015
Wood			
Planed, untreated	0.010	0.012	0.014
Planed, creosoted	0.011	0.012	0.015
Unplaned	0.011	0.013	0.015

Wood plank with battens	0.012	0.015	0.018
Concrete			
Trowel finish	0.011	0.013	0.015
Float finish	0.013	0.015	0.016
Finished, with gravel on bottom	0.015	0.017	0.020
Unfinished	0.014	0.017	0.020
Concrete on good excavated rock	0.018	0.020	---
Concrete on irregular excavated rock	0.022	0.027	---
Gravel bottom			
sides of Formed concrete	0.017	0.020	0.025
sides of Random stone in mortar	0.020	0.023	0.026
sides of Dry rubble or rip-rap	0.023	0.033	0.036
Brick			
Glazed	0.011	0.013	0.015
in cement mortar	0.012	0.015	0.018
Asphalt			
Smooth	0.013	0.013	---
Rough	0.016	0.016	---
Vegetated lining	0.030	---	0.500

Source: [Chow,1959]

Table 2.14 Manning Roughness Coefficient for Minor Natural Streams

Type of Channel and Description	Minimum	Normal	Maximum
a. Streams on plain			
1. Clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
2. Same as above, but some stones and weeds	0.030	0.035	0.040
3. Clean, winding, some pools and shoals	0.033	0.040	0.045
4. Same as above, but some weeds and stones	0.035	0.045	0.050
5. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
6. Same as 4, but more stones	0.045	0.050	0.060
7. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8. Very weedy reaches, deep pools, or floodways with heavy stand of, timber and underbrush	0.075	0.100	0.150
b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
1. Bottom: gravels, cobbles and few boulders	0.030	0.040	0.050
2. Bottom: cobbles with large boulders	0.040	0.050	0.070

Source: [Chow, 1959]

Note: A "minor stream" is one which has a top width of less than 100 feet at flood stage.

Table 2.15 Manning Roughness Coefficient for Major Natural Streams

Type of Channel and Description	Minimum	Normal	Maximum
Regular section with no boulders or brush	0.025	---	0.060
Irregular and rough section	0.035	---	0.100

Source: [Chow, 1959]

Note: A “major stream” is one with a top width of more than 100 feet at flood stage. The *n*-value is less than that for minor streams of similar description because banks offer less effective resistance.

Table 2.16 Manning Roughness Coefficient for Flood Plains

Type of Channel and Description	Minimum	Normal	Maximum

Pasture, no brush			
Short grass	0.025	0.030	0.035
High grass	0.030	0.035	0.050
Cultivated areas			
No crop	0.020	0.030	0.040
Mature row crops	0.025	0.035	0.045
Mature field crops	0.030	0.040	0.050
Brush			
Scattered brush, heavy weeds	0.035	0.050	0.070
Light brush and trees, in winter	0.035	0.050	0.060
Light brush and trees, in summer	0.040	0.060	0.080
Medium to dense brush, in winter	0.045	0.070	0.110
Medium to dense brush, in summer	0.070	0.100	0.160
Trees			
Dense willows, summer, straight	0.110	0.150	0.200
Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
Same as above, w/ heavy growth of sprouts	0.050	0.060	0.080
Heavy stand of timber, a few down trees, little undergrowth, flood-stage below branches	0.080	0.100	0.120
Same as above, w/ flood stage reaching branches	0.100	0.120	0.160

Source: [Chow, 1959]

2.6.3 OPEN CHANNEL DESIGN

The proper hydraulic design of a channel is of primary importance in ensuring that flooding, sedimentation and erosion problems do not occur. The following general criteria should be used in the design of open channels:

A. Design Criteria: The design criteria for storm drainage shall be based upon the data prepared by NC Department of Transportation Guidelines for Drainage Structures, latest revision, USDOT Federal Highway Administration Urban Drainage Design Manual, Hydraulic Engineering Circular No. 22, the NC Erosion and Sediment Control Planning and Design, latest revision, the NCDENR Stormwater Best Management Practices Manual), the SCS National Engineering Field Manual for Conservation Practices, or other acceptable calculation procedures. Designers may refer to:

https://connect.ncdot.gov/resources/hydro/Pages/default.aspx
http://portal.ncdenr.org/web/lr/publications
http://portal.ncdenr.org/web/lr/bmp-manual.

B. Design Frequencies for Open Channel Design

1. All open channels in the Town of Wake Forest shall be designed to contain the runoff from 10 year frequency storm. In addition, the channel must be designed to have sufficient freeboard to provide for adequate drainage of lateral storm sewers during the 25-year/24-hour storm and in some cases even the 100-year/24-hour frequency storm. For example, when a newly designed open channel is being constructed between two existing structures or adjacent to an existing structure, then the channel section must be evaluated using the 100-year/24-hour frequency storm. This will ensure that the existing structures are not flooded frequently. In a naturalized area where the newly constructed channel ties into a natural stream or creek, then the channel is to be evaluated using the 25-year frequency storm.

See also Table 2.6, Design and Check Storms.

2. In those cases where channel modifications are necessary to control increased flow from proposed development, proposed water surface profiles are

restricted such that the 100-year flood profile under existing conditions shall not be increased. If the capacity of the existing channel downstream of the project is less than the 100-year design discharge, consideration shall be given for more frequent events to ensure that the severity and frequency of downstream flooding are not increased.

C. Required Documentation for Open Channel Designs

The following information must be submitted to the Town of Wake Forest for the design of open channels, but is not limited the following:

1. **Vicinity Map**: A vicinity map of the site and subject reach.
2. **Site Map**: A detailed map of the area and subject reach.
3. **Watershed Map**: A watershed map showing existing and proposed drainage area boundaries along with all sub-area delineations and all areas of existing or proposed development.
4. **Discharge Calculations**: Discharge calculations specifying the methodology and key assumptions used, along with computed discharges at key locations. The designer's calculations shall include the runoff from the property being developed and the runoff from contributing off site areas, assuming ultimate development in accordance with the current zoning regulations and the Unified Development Ordinance.
5. **Hydraulic Calculations**: Hydraulic calculations specifying the methodology used. All assumptions and values of design parameters must be clearly stated.
6. **Plotted Cross-Sections**: Typical existing and proposed cross-sections.

D. Channel Flow Velocities

Excessive flow velocities in open channels can cause erosion and destabilize side slopes, and may pose a threat to safety. Velocities which are too low may allow the deposition of sediment and subsequent channel clogging. Table 2.17 provides desirable average and maximum allowable velocities based on 10-year flow rates.

Table 2.17 Allowable Flow Velocities for Channel Design

Channel Description	Average Velocity (Feet Per Second)	Maximum Velocity (Feet Per Second)
Grass Lined: Predominantly Clay Soils	3.0	4.0
Grass Lined: Predominantly Sand Soils	2.0	4.0
Rip-Rap Lined	5.0	8.0
Concrete Lined	6.0	10.0

E. Channel Flow-Line Slope: Slope of the channel flow-line (invert) is generally governed by topography and the energy head required for flow. Since flow-line slope directly affects channel velocities, channels should have sufficient grade to prevent significant siltation. However, slopes should not be so large as to create erosion problems. In the Town of Wake Forest, the minimum recommended longitudinal slope shall be 0.5 percent (0.005). The use of flatter slopes must be approved by the Town's Engineer. The maximum channel invert slope will be limited by the maximum flow velocities given in Table 2.17. Appropriate channel drop structures may be used to limit channel invert slopes in steep areas.

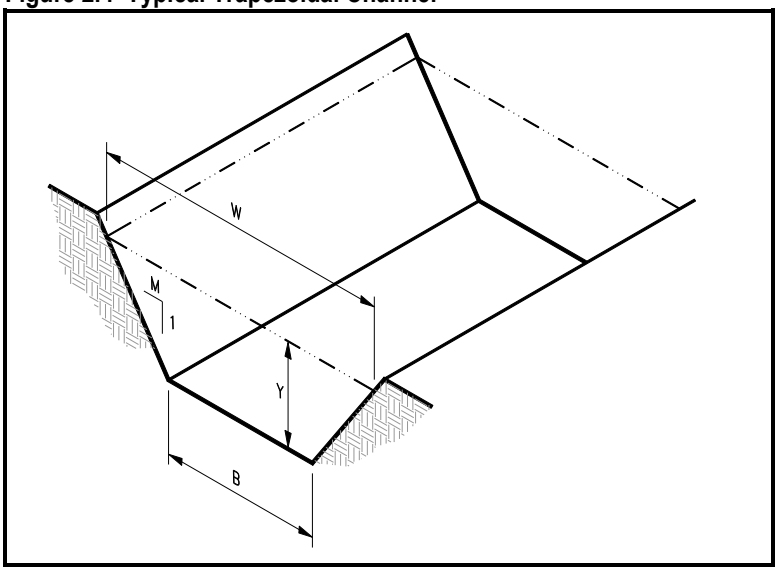
F. Channel Side Slope: In grass-lined channels, the normal maximum side slope will be 3 horizontal to 1 vertical (3:1), which is the practical limit for mowing

equipment. In some areas, local soil conditions may dictate the use of side slopes flatter than 3:1 to ensure slope stability.

G. Channel Bottom Width: In grass-lined channels, the minimum channel bottom width shall be three (3) feet. In concrete-lined channels, the minimum bottom width shall be two (2) feet.

H. Trapezoidal Channel Design: In trapezoidal design applications, Figure 2.4 and Equations 2.3 through 2.6 help define the variables used to solve the Manning equation.

Figure 2.4 Typical Trapezoidal Channel



Where,

W → Top width of flow, measured in feet.

B → Bottom width of the channel, measured in feet.

y → Depth of flow, measured in feet.

M → Side slope ratio (ft. horizontal / ft. vertical).

(For a 2 to 1 side slope, the value of M is 2.)

P → Represents the wetted perimeter.

The following equations are derived geometrically, and the units of the variables are consistent with those given above:

$$A = By + My^2 \qquad \textbf{(Equation 2.3)}$$

$$P = B + 2y\sqrt{(1+M^2)} \qquad \textbf{(Equation 2.4)}$$

$$W = B + 2My \qquad \textbf{(Equation 2.5)}$$

$$R = \frac{A}{P} \qquad \textbf{(Equation 2.6)}$$

I. **Manning Roughness Coefficient – Improved Channels:** The values of the Manning roughness coefficient listed in Table 2.18 should be used in the design of channel improvements. Alternative values should be discussed with the Town's Engineer.

Table 2.18 Manning Roughness Coefficient for Improved Channels

Channel Cover	"*n*" Value
Bare Soil	0.025
Grass-Lined	0.040
Rip-Rap Lined	0.070
Concrete Lined	0.013

2.6.4 CHANNEL PROTECTION

A. Erosion protection is necessary to ensure that channels maintain their capacity and stability and to avoid excessive transport and deposition of eroded material.

B. Drainage Ways

1. Development shall adequately protect all ditches and drainage ways to the satisfaction of the Town, as noted in Section 2.4.6.D. Ditches and open channels shall be stabilized, seeded, and mulched, sodded or armored, depending on grades and types of soils. As a general rule, ditches and channels, when permitted, shall be lined a follows:

Table 2.19 Ditch Liners

Slope	Liner
up to 1%	Seeded, mulched and tacked
1% to 4%	Turf Reinforcement
over 4%	Concrete/Gabions/Other Approved Armored Liners

2. Seeding, sodding, and armoring operations shall be in compliance with the NCDOT Standard specifications for Roads and Structures, latest edition. It is not sufficient to have merely planted according to these specifications; there must be a good stand of permanent grass maintained to meet this requirement. Calculations shall be made to determine the need for riprap outlet protection at pipe outlets.

C. Easements: The watercourse or ditch easement shall be wide enough to contain said ditch with ample clearance for the operation of maintenance equipment. The minimum easement width shall be per Section 6.10.1 of the Town of Wake Forest Unified Development Ordinance (UDO), Appendix B.

D. Downstream Protection: Stream banks and channels downstream from the development shall be protected from increased degradation by accelerated erosion caused by increased velocity of runoff from the construction activity. Supporting calculations may be required at the discretion of the Town's Engineer.

See paragraphs 2.6.5 Channel Erosion Control and 2.7.4 Culvert Erosion Control, below, for downstream channel design requirements.

E. Upstream Protection:

1. Maximum allowable high water levels should be established along the storm drainage system prior to **initiating hydraulic e**valuations.
2. The **headwater elevation** of existing streams or pipe culverts upstream of the proposed development shall not be increased above the pre-development elevations from either the design storms shown in Table 2.6 or from a 100-year 24-hour storm event, whichever is greater.
3. Small drainage basins upstream of the proposed development shall be given consideration for the potential of flooding due to short duration high intensity storm events.
4. When applicable, evaluation of an upstream drainage basin shall be given consideration for the potential of grate clogging (i.e. yard and roadway grated inlets). **Assume a clogging factor of 50% for single grates in a sump condition.**
5. Any evaluation of the upstream drainage basin shall consider the potential impact of flooding existing upstream basements or near grade finished floors (slab-on-grade or crawl space) and make allowances to prevent the new development from increasing the pre-existing high water elevation.

2.6.5 CHANNEL EROSION CONTROL

A. All erosion and sediment control measures shall be designed in accordance with the North Carolina Sedimentation Pollution Control Act of 1973, and the North Carolina Erosion and Sediment Control Handbook, latest edition. http://portal.ncdenr.org/web/lr/publications

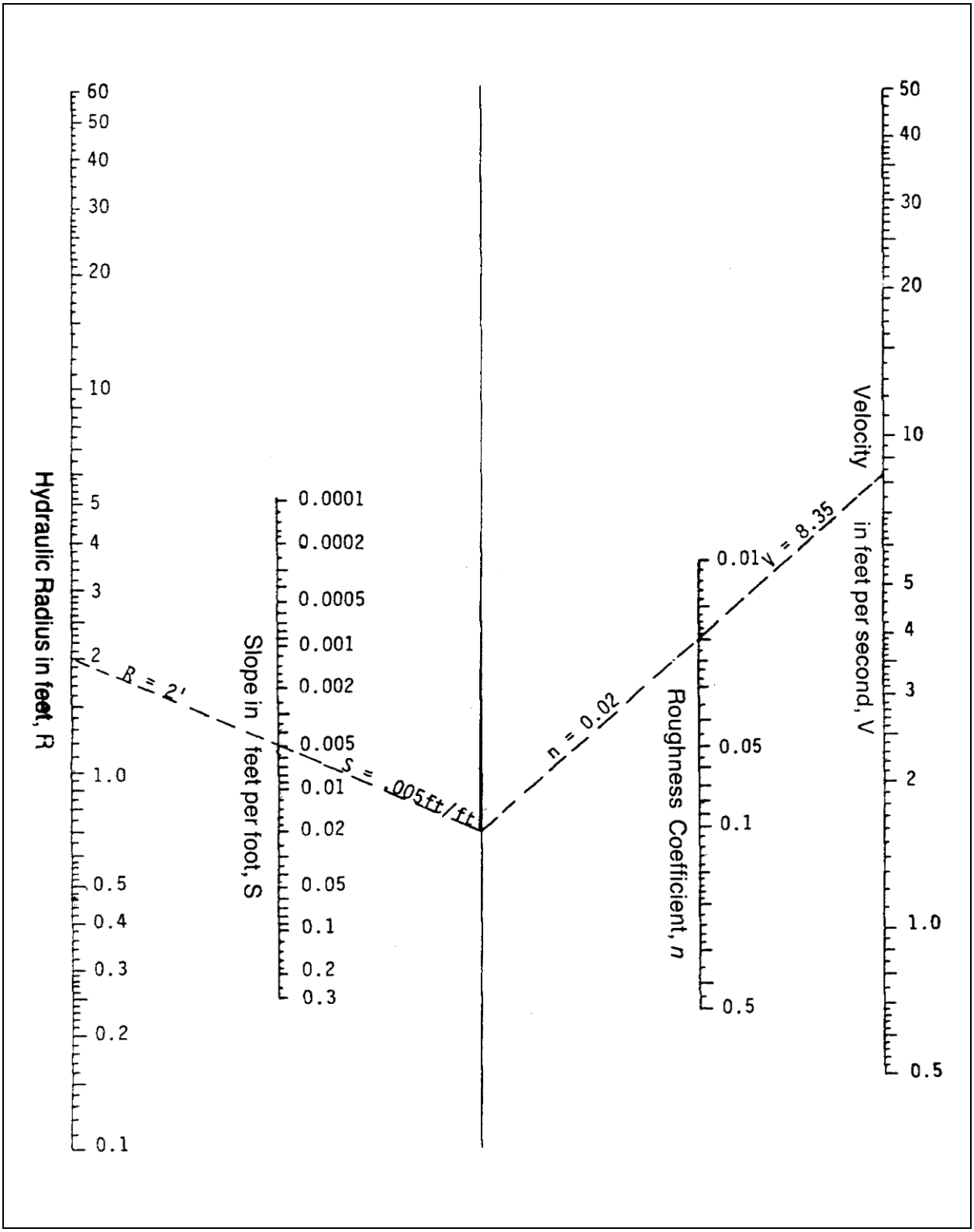
B. All Erosion and Sediment Control Plans measures shall be designed in accordance with the North Carolina Sediment Control Law and the Take of Wake Forest's Unified Development Ordinance, whichever is more stringent. The designer is to also reference this Manual of Specifications, Standards, and Design with regard to certain erosion control details required to be made part of the erosion and sedimentation control plan.

C. The Town of Wake Forest has local review authority for erosion and sedimentation control plans. Erosion and Sedimentation Control plans, permit applications and fees shall be submitted to the Town of Wake Forest Engineering Department for review and approval.

2.6.6 DESIGN AIDS

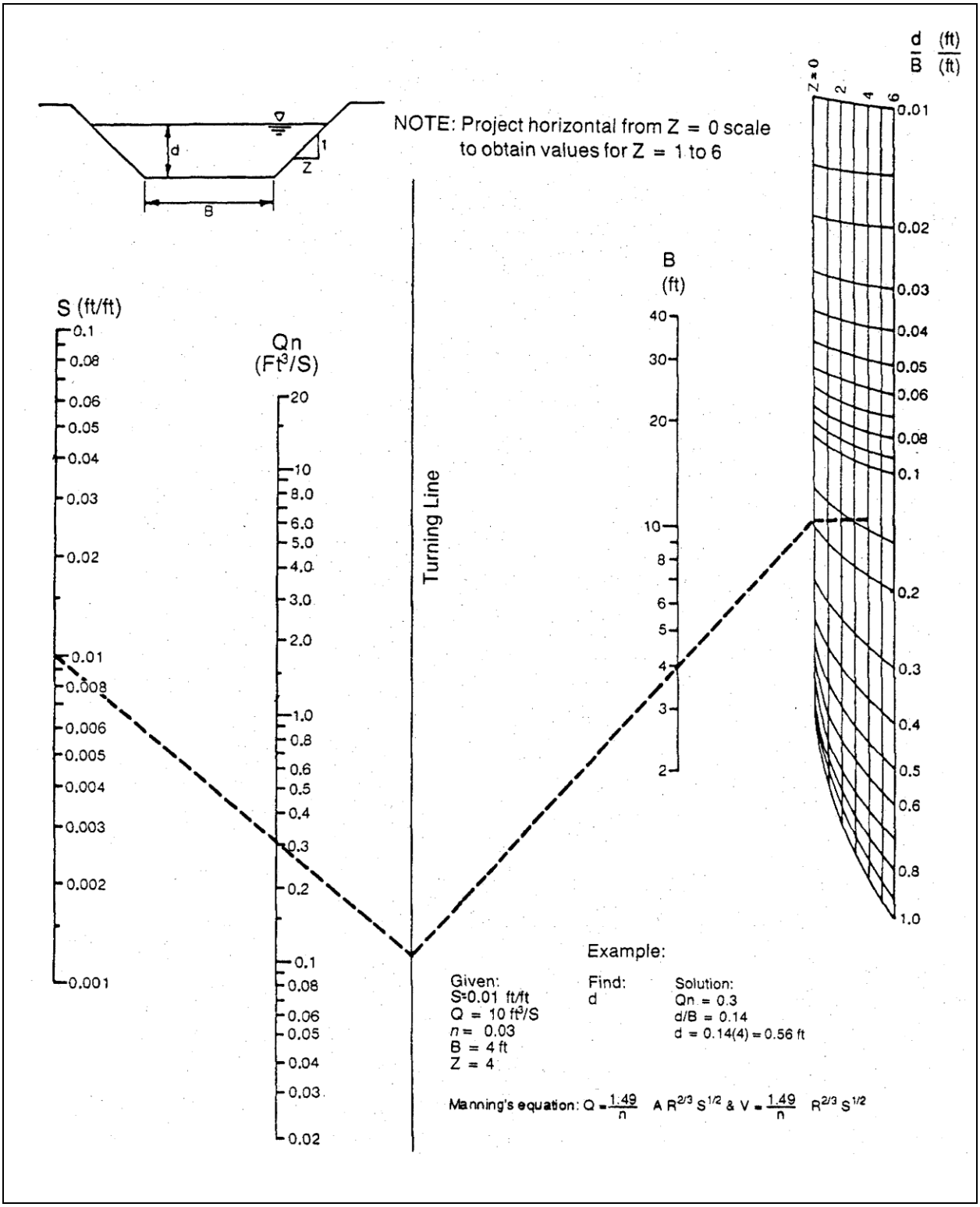
The following will aid in open channel design:

Figure 2.5 Nomograph for Solution of Manning Equation



Source: [FHWA – HEC-15,1988]

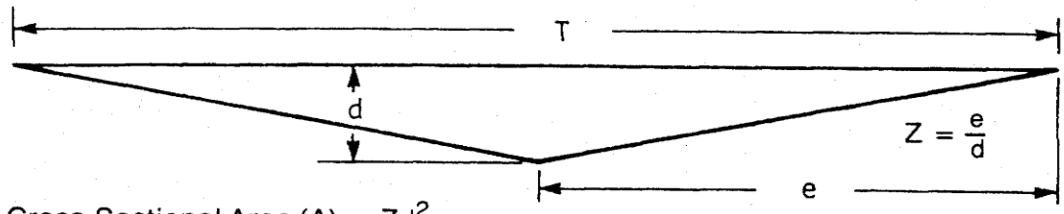
Figure 2.6 Solution of Manning's Equation for Trapezoidal Channels of Various Slope



Source: [FHWA – HEC-15, 1988]

Figure 2.7 Channel Geometries for V-Shape, Parabolic and Trapezoidal Channels

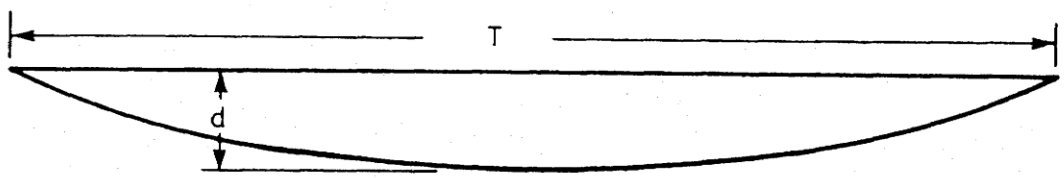
V-Shape



Cross-Sectional Area (A) = Zd^2
Top Width (T) = $2dZ$

Hydraulic Radius (R) = $\dfrac{Zd}{2\sqrt{Z^2 + 1}}$

Parabolic Shape

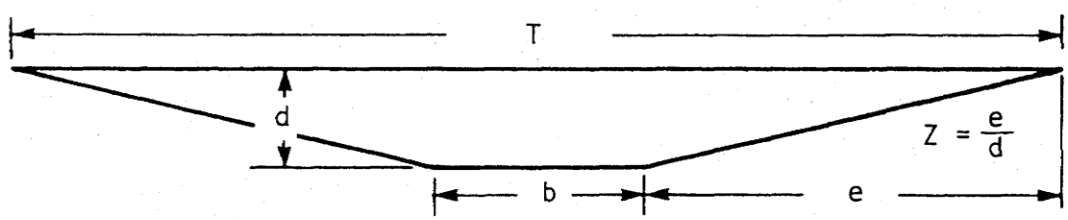


Cross-Sectional Area (A) = $\frac{2}{3}$ Td

Top Width (T) = $\dfrac{1.5\,A}{d}$

Hydraulic Radius = $\dfrac{T^2 d}{1.5T^2 + 4d^2}$

Trapezoidal Shape



Cross-Sectional Area (A) = $bd + Zd^2$
Top Width (T) = $b + 2dZ$

Hydraulic Radius = $\dfrac{bd + Zd^2}{b + 2d\sqrt{Z^2 + 1}}$

Source: ["E&S Control Planning and Design Manual," DEHNR, May 1994 Revised]

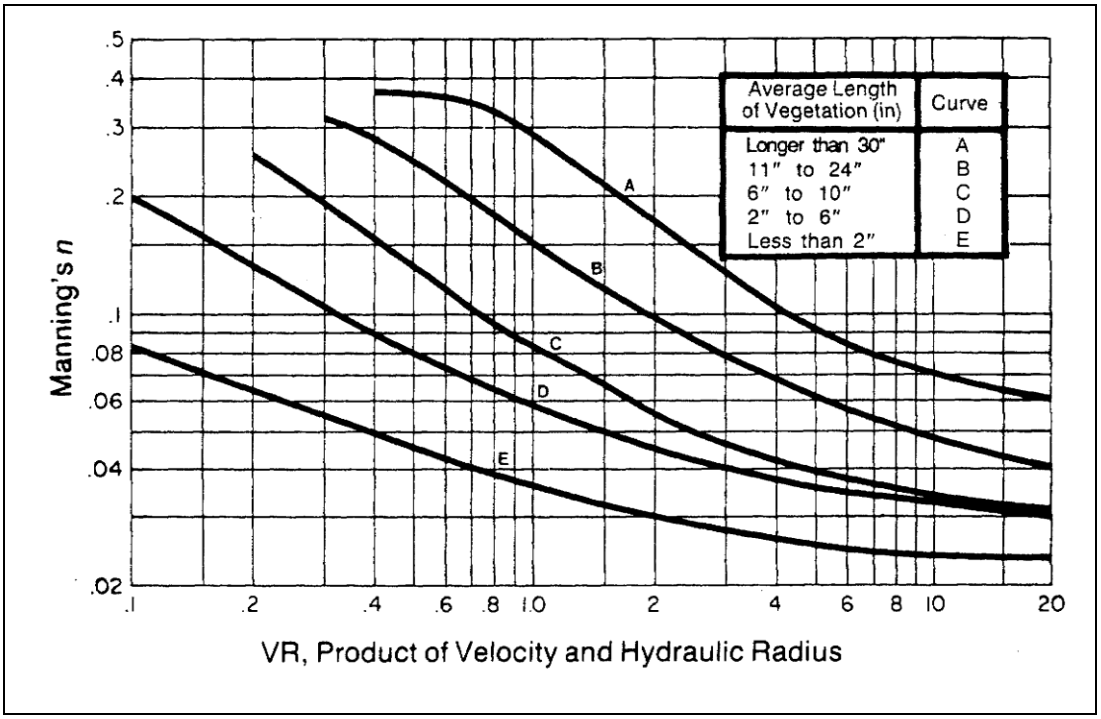
Table 2.20 Maximum Allowable Design Velocities for Vegetated Channels

Typical Channel Slope Application	Soil Characteristics[2]	Grass Lining	Permissible Velocity[3] for Established Grass Lining (ft/sec)
0-5%	Easily Erodible Non-Plastic (Sands & Silts)	Bermudagrass	5.0
		Tall Fescue	4.5
		Bahiagrass	4.5
		Kentucky bluegrass	4.5
		Grass-legume mixture	3.5
	Erosion Resistant Plastic (Clay Mixes)	Bermudagrass	6.0
		Tall Fescue	5.5
		Bahiagrass	5.5
		Kentucky bluegrass	5.5
		Grass-legume mixture	4.5
5-10%	Easily Erodible Non-Plastic (Sands & Silts)	Bermudagrass	4.5
		Tall Fescue	4.0
		Bahiagrass	4.0
		Kentucky bluegrass	4.0
		Grass-legume mixture	3.0
	Erosion Resistant Plastic (Clay Mixes)	Bermudagrass	5.5
		Tall Fescue	5.0
		Bahiagrass	5.0
		Kentucky bluegrass	5.0
		Grass-legume mixture	3.5
>10%	Easily Erodible Non-Plastic (Sands & Silts)	Bermudagrass	3.5
		Tall Fescue	2.5
		Bahiagrass	2.5
		Kentucky bluegrass	2.5
	Erosion Resistant Plastic (Clay Mixes)	Bermudagrass	4.5
		Tall Fescue	3.5
		Bahiagrass	3.5
		Kentucky bluegrass	3.5

Source: USDA-SCS Modified

NOTE: 1. Permissible Velocity based on 10-yr storm peak runoff.
2. Soil erodibility based on resistance to soil movement from concentrated flowing water.
3. Before grass is established, permissible velocity is determined by the type of temporary liner used.

Figure 2.8 Manning's "*n*" Related to Velocity, Hydraulic Radius and Vegetal Retardance



Source: [E&S Control Planning and Design Manual," NCDENR, May 1994 Revised]

Table 2.21 Retardance Classification for Vegetal Covers

Retardance	Cover	Condition
A	Reed canarygrass	Excellent stand, tall (average 36”)
	Weeping lovegrass	Excellent stand, tall (average 30”)
B	Tall fescue	Good stand, uncut (average 18”)
	Bermudagrass	Good stand, tall (average 12”)
	Grass-legume mixture (tall fescue, red fescue, sericea lespedeza)	Good stand, uncut
	Grass mixture (timothy, smooth bromegrass, or orchardgrass)	Good stand, uncut (average 20”)
	Sericea lespedeza	Good stand, not woody, tall (average 19”)
	Reed canarygrass	Good stand, cut (average, 12-15”)
	Alfalfa	Good stand, uncut (average 11”)
C	Tall fescue	Good stand (8-12”)
	Bermudagrass	Good stand, cut (average 6”)
	Bahiagrass	Good stand, uncut (6-8”)
	Grass-legume mixture- Summer (orchardgrass, redtop, and annual lespedeza)	Good stand, uncut (6-8”)
	Centipedegrass	Very dense cover (average 6”)
	Kentucky bluegrass	Good stand, headed (6-12”)
	Redtop	Good stand, uncut (15-20”)
D	Tall fescue	Good stand, cut (3-4”)
	Bermudagrass	Good stand, cut (2.5”)
	Bahiagrass	Good stand, cut (3-4”)
	Grass-legume mixture- Fall-spring (orchardgrass, redtop, and annual lespedeza)	Good stand, uncut (4-5”)
	Red fescue	Good stand, uncut (12-18”)
	Cenitpedegrass	Good stand, cut (3-4”)
	Kentucky bluegrass	Good stand, cut (3-4”)
E	Bermudagrass	Good stand, cut (1.5”)
	Bermudagrass	Burned stubble

Modified from: USDA-SCS, 1969. Engineering Field Manual.

2.7 CULVERT DESIGN

The purpose of this section is to establish standard procedures and criteria for Culvert Design for the Town of Wake Forest.

2.7.1 INTRODUCTION

A. Drainage culverts shall be designed for the appropriate design and check storm per Table 2.6.

B. The designer's calculations shall include the runoff from the property being developed and the runoff from contributing off-site areas, assuming ultimate development in accordance with the current zoning regulations and the Land Use Plan.

2.7.2 CURB INLET DESIGN

A. Curb storm drainage inlets shall be provided at intervals along roadways. Where these inlets connect to storm sewers, a catch basin shall be installed with the inlet.

B. The Town of Wake Forest uses the design procedures of Hydraulic Engineering Circular No. 22 (HEC 22), Urban Drainage Design Manual (HEC 12 "Drainage of Highway Pavements" was updated by the report of HEC 22). The procedures within HEC 22 analyze flow in gutters and the interception capacity of grate, curb-opening and slotted drain inlets as well as combination inlets.

C. For curb and gutter inlets, a minimum intensity of 2 year storm at 5 minute time of concentration shall be used in all computations.

D. Inlet spacing and sizing shall be adequate to limit the spread of water to ½ the travel lane into the roadway. The travel lane is the outside lane and does not include the gutter section.

Allowances shall be given for the potential of clogging at sumps. Due to clogging characteristics, the use of slotted drains alone are not recommended in sag locations.

Table 2.22 Recommended Clogging Factors in Sump Condition[1]

1	0.50	0.12
2	0.35	0.08
3	0.25	0.05
4	0.15	0.03

[1] Table 10.1, Urban Hydrology and Hydraulic Design, James C. Y. Guo, Water Resources Publication, LLC, (Observed Conditions).

E. The curb inlet design procedure is based on the standard Town of Wake Forest curb inlet with a 4-foot opening. Inlets capture most of the water entering the pipe system. The following procedure is used to locate inlets, however, other factors shall be considered such as location of the low points, intersections and layout of the pipe system.

1. Determine the maximum gutter flow from the nomograph "Flow in triangular gutter sections" (Figure 2.9) The known values of:

a. S = Street longitudinal slope,

b. S_x = Street cross slope,

c. T = 8 feet (the maximum allowable spread), and

d. n = Manning's roughness coefficient are used to solve for the gutter capacity, Q.

2. Determine the location of the inlet using the rational formula rearranged such that:

$$A = \frac{Q}{Ci} \qquad \textbf{(Equation 2.7)}$$

Where,

Q → The peak rate of runoff in cubic feet per second (cfs). Actually, Q is in units of inches per hour per acre.

C → The dimensionless coefficient of runoff representing the ratio of peak discharge per acre to rainfall intensity (i).

i → The average intensity of rainfall in inches per hour for a period of time equal to the time of concentration for the drainage area at the point of interest.

A → The area in acres contributing runoff to the point of interest during the critical storm duration.

Locate the first inlet by trial and error using the existing site contours and the proposed designed plan such that the area of the sub-drainage area does not exceed the capacity determined using Equation 2.7. Remember to check the "*C*" value for the actual area determined.

3. The next inlets are located utilizing Figure 2.9 and 2.10. Determine the required curb opening length, Lt, and enter in Figure 2.10, with the ratio L/Lt where L is the actual curb opening in feet for Town of Wake Forest standard curb inlets. This will yield the percentage of flow intercepted by each basin. The remainder of this flow shall be considered in determining the location of the next downstream inlet. This procedure is repeated as necessary. The designer is encouraged to use the Catch Basin Design and Data Sheet, Figure 2.10.

2.7.3 PIPE CULVERT DESIGN - GENERAL

A. Pipe culverts shall be aligned parallel to the longitudinal axis of the channel, as much as possible, to ensure maximum hydraulic efficiency and to minimize erosion. In areas where a change in alignment is necessary, the change shall be accomplished upstream of the culvert in the open channel. Appropriate erosion protection shall be provided.

B. Pipe culverts crossing beneath the roadway shall be designed to span from ditch line to ditch line.

C. All pipe culverts are required to have Flared End Sections or Headwall/Endwalls.

D. The minimum pipe culvert diameter shall be 15 inches to minimize clogging and maintenance for all pipe culverts within Town of Wake Forest rights-of-ways and easements.

E. All pipe culverts to be minimum Class III reinforced concrete with minimum pipe cover equal to 2 feet, measured from the proposed finished grade to the top of the pipe. Refer to Table 2 of Standard Detail 9.53 for the applicable laying conditions.

F. Double Walled Corrugated HDPE is allowed outside of right-of-way only.

2.7.4 CULVERT EROSION CONTROL

A. Inlet and/or outlet protection is necessary to ensure those channels upstream and downstream of pipe culverts maintain stability and to avoid excessive transport and deposition of eroded material. Stream banks and channels downstream from any land disturbing activity shall be protected from increased degredation by accelerated erosion caused by increased velocity of runoff from the land disturbing activity.

B. All erosion and sediment control measures shall be designed in accordance with the North Carolina Sedimentation Pollution Control Act of 1973. The Designer is to reference the latest edition of the Erosion and Sediment Control Planning and Design Manual. This manual contains valuable information and tools for developing plans to minimize soil erosion and prevent sedimentation pollution associated with land-disturbing activities.

C. Persons shall conduct land disturbing activity so that the post construction velocity of runoff of the ten-year or twenty-five year storm (depending on watershed or HQW zone)in the receiving watercourse to the discharge point does not exceed the greater of:

a. The velocity established by the Maximum Permissible Velocities Table or

b. The velocity of the ten-year storm runoff in the receiving watercourse prior to the development.

c. If condition 1 or 2 cannot be met, then the receiving watercourse to and including the discharge point shall be designed and constructed to withstand the expected velocity anywhere the velocity exceeds the pre development velocity by 10%.

Maximum Permissible Velocities Table

Material	Velocity (fps)
Fine sand (noncolloidal)	2.5
Sandy Loam (noncolloidal)	2.5
Silt Loam (noncolloidal)	3.0
Ordinary firm loam	3.5
Fine gravel	5.0
Stiff clay (very colloidal)	5.0
Graded, loam to cobbles (noncolloidal)	5.0
Graded, silt to cobbles (colloidal)	5.5
Alluvial silts (noncolloidal)	3.5
Alluvial silts (colloidal)	5.0
Course gravel (noncolloidal)	6.0
Cobbles and shingles	5.5
Shales and hard pans	6.0

Source: [adopted from recommendations by Special Committee on Irrigation Research, American Society of Civil Engineering 1926, for channels with straight alignment. For sinuous channels, multiple allowable velocity by 0.95 for slightly sinuous, 0.90 for moderately sinuous, and by 0.80 for highly sinuous channels]

D. Acceptable Management Measures - Measures applied along or in combination to satisfy the intent of the Ordinance area acceptable if there are no objectionable secondary consequences. The Town recognizes that the management of storm water runoff to minimize or control downstream channel and bank erosion is a developing technology. Innovative techniques and ideas will be considered and may be used when shown to the potential to produce successful results. Some alternatives, while not exhaustive are to:

a. Avoid increases in surface runoff volume and velocity by including measures to promote infiltration to compensate for increased runoff from areas rendered impervious.

b. Avoid increased in storm water discharge velocities by using vegetated or roughened swales and waterways in place of closed drains and high velocity paved sections.

c. Provide energy dissipaters at outlets of storm drainage facilities to reduce flow velocity at the point of discharge from the development; these may range from simple riprap sections to complex structures.

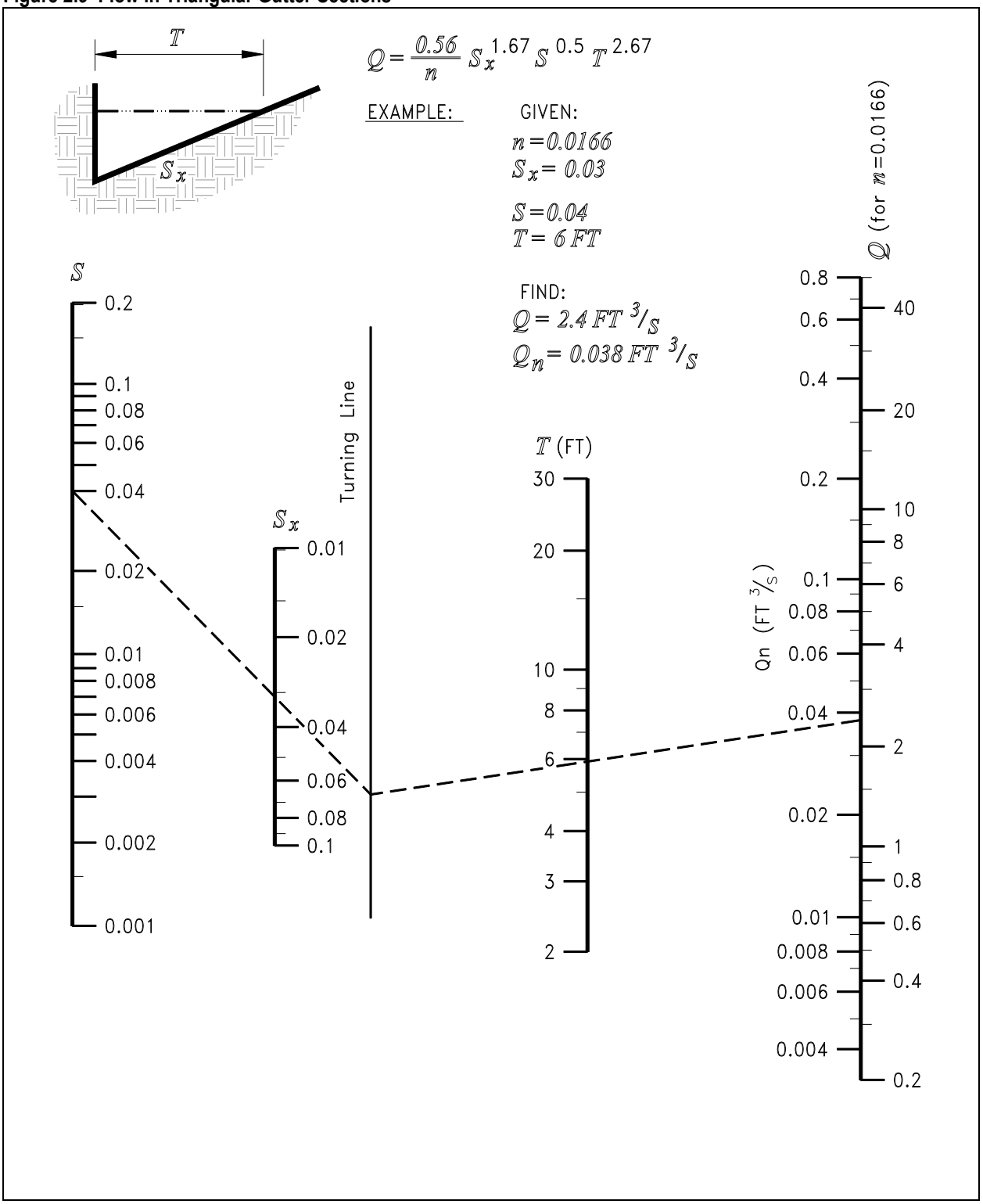
d. Protect watercourses subject to accelerated erosion by improving sections and/or providing erosion resistant lining.

e. Upgrade or replace the receiving device structure, or watercourse such that it will receive and conduct the flow to a point where it is no longer subject to degradation from the increased rate of flow or increased velocity.

2.7.5 DESIGN AIDS

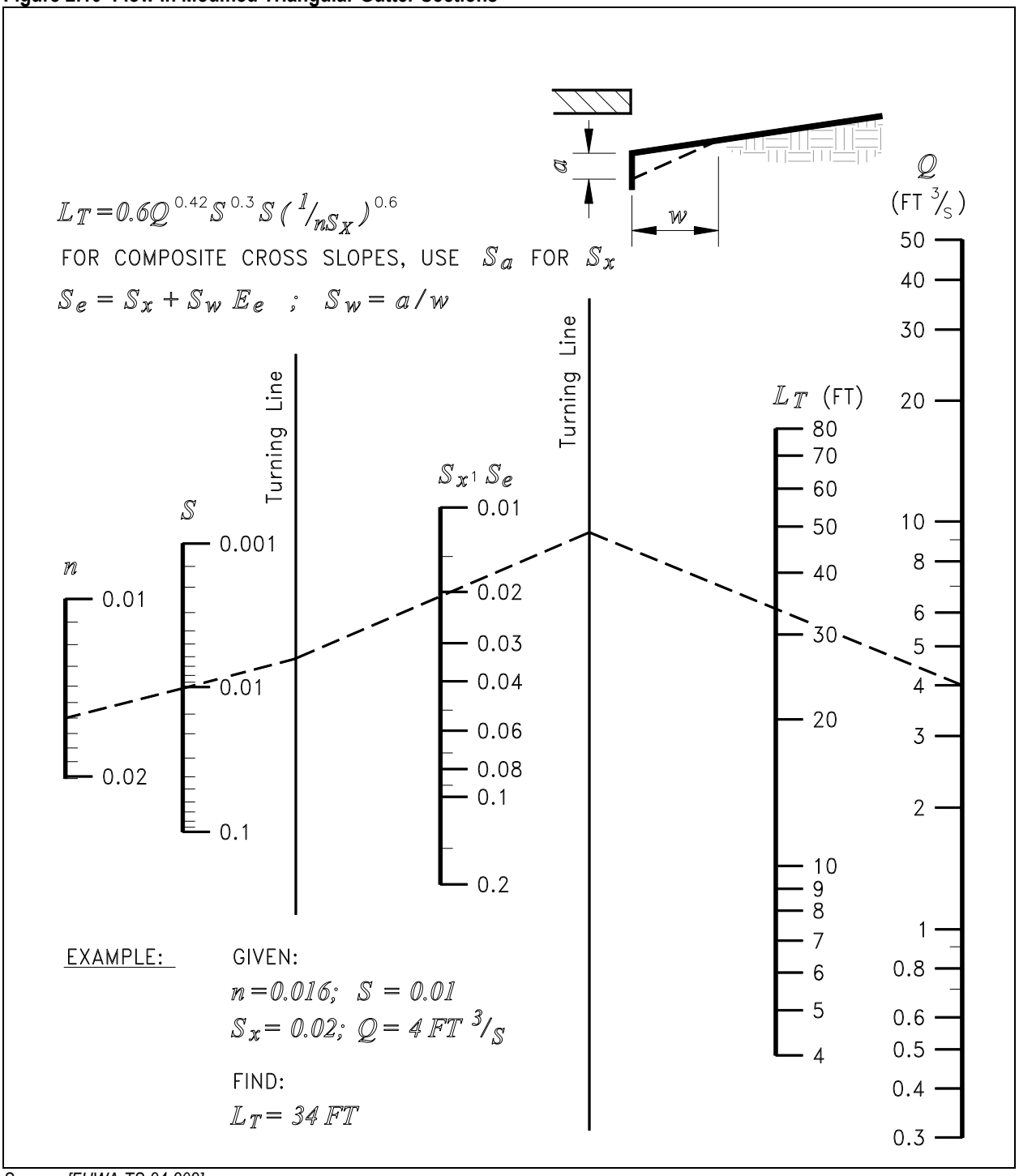
The following charts, tables, figures, etc., will aid in pipe culvert design:

Figure 2.9 Flow in Triangular Gutter Sections



Source: [FHWA-TS-84-202]

Figure 2.10 Flow in Modified Triangular Gutter Sections



Source: [FHWA-TS-84-202]

Figure 2.11 Catch Basin Design Data Sheet

CATCH BASIN DESIGN DATA SHEET

SHEET: /

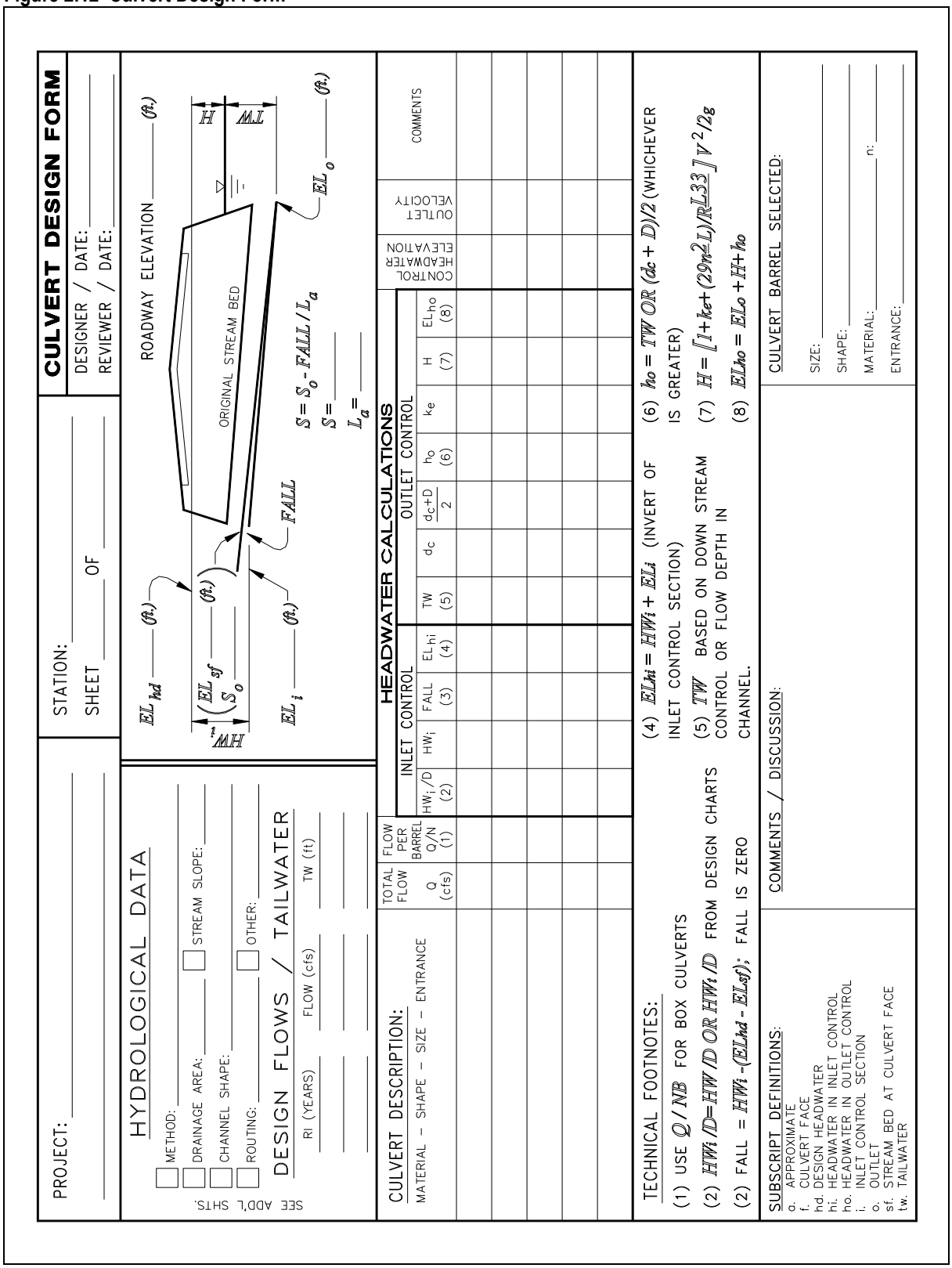
PROJECT:
LOCATION
STORM FREQUENCY: Years

COMPUTED BY: DATE:
CHECKED BY: DATE:

	1	2	3	4	5	6	7	8	9	10	11	12	13	
CATCH BASIN NO.	GUTTER SPREAD	LONGITUDINAL GRADE	MAX. GUTTER FLOW (CFS)	INTERCEPTED FLOW (CFS)	TRIAL COEF. OF RUNOFF	TRIAL INTENSITY (IN.)	DERIVED AREA	LENGTH OF DRAINAGE AREA	HEIGHT ABOVE MOST REMOTE POINT	COEFFICIENT OF RUNOFF	TIME OF CONCENTRATION	ACTUAL INTENSITY (IN.)	MAX. ALLOWABLE DRAINAGE AREA	REMARKS (COLUMN 13 MUST BE W/IN 10% OF COLUMN 7)

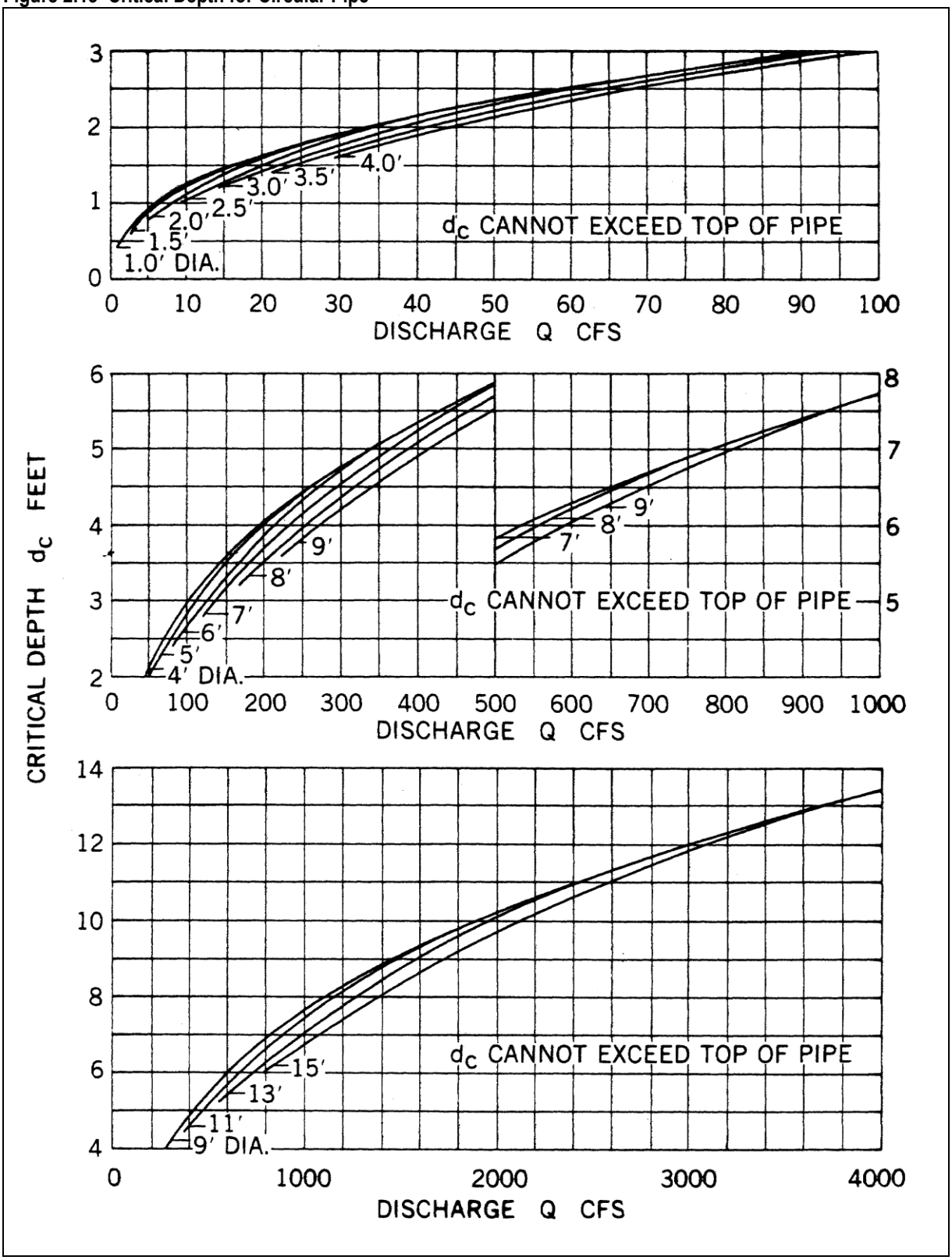
Source: City of Wilmington Technical Standards and Design, [July 1996]

Figure 2.12 Culvert Design Form



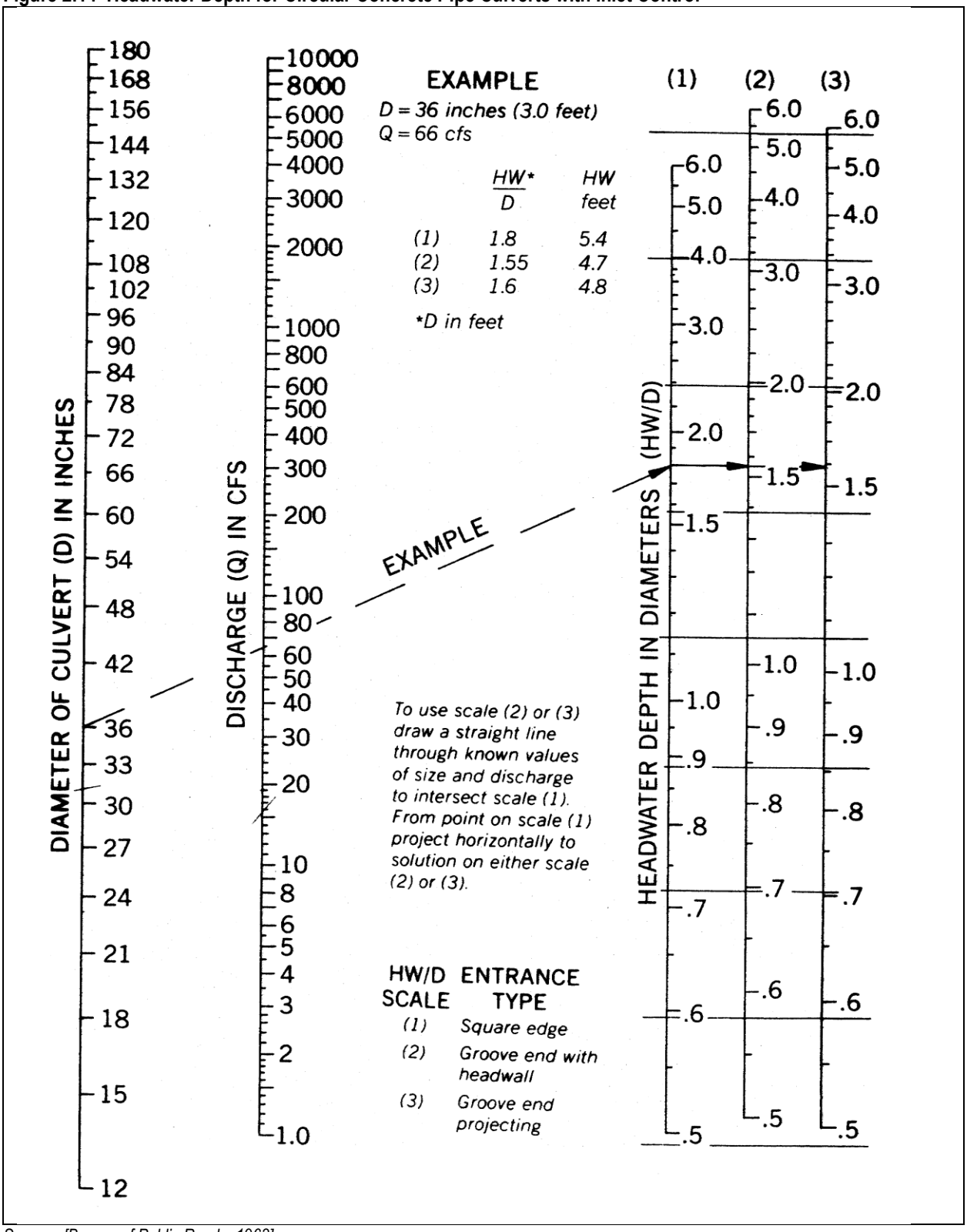
Source: "Drainage Criteria Manual for Montgomery County, Texas," [Dodson, 1989]

Figure 2.13 Critical Depth for Circular Pipe



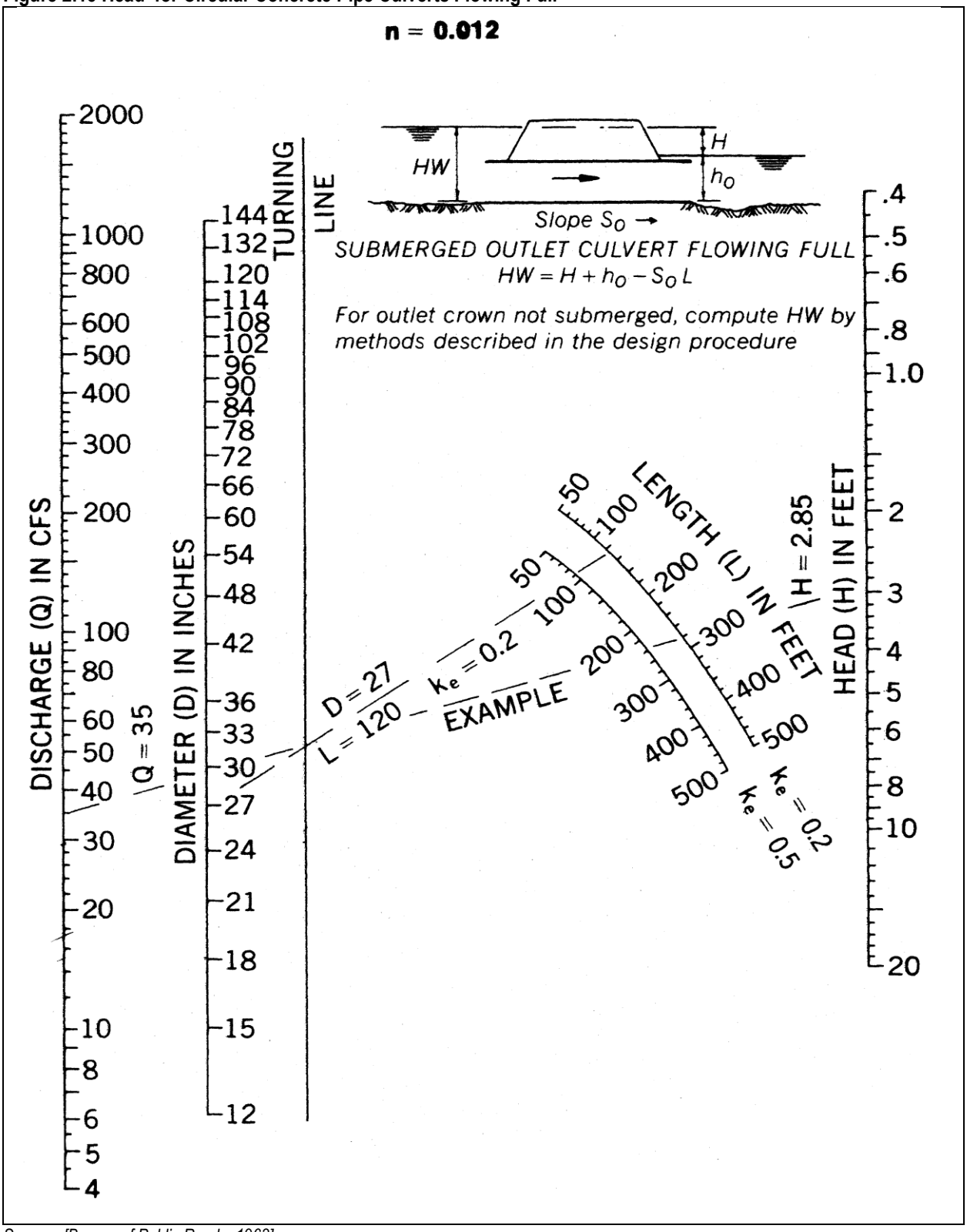
Source: [Bureau of Public Roads, 1963]

Figure 2.14 Headwater Depth for Circular Concrete Pipe Culverts with Inlet Control



Source: [Bureau of Public Roads, 1963]

Figure 2.15 Head for Circular Concrete Pipe Culverts Flowing Full



Source: [Bureau of Public Roads, 1963]

2.8 BEST MANAGEMENT PRACTICES (BMPs)

2.8.1 INTRODUCTION

A. Management of nonpoint source discharge is a stated goal of the 1987 Water Quality Act. An important source of these pollutants is stormwater runoff from urban and developing areas. This runoff has the potential to degrade water quality in all types of waters, including, among others, those classified as water supply watersheds, shellfish areas, and nutrient sensitive waters. The management of stormwater runoff through nonstructural controls (e.g., low-density development) is the preferred method of reducing pollution from urban areas. In cases where low density is not feasible, engineered stormwater controls are viable solution to reducing pollution. However, proper design, and subsequent management, of these engineered solutions is essential for adequate pollutant removal.

B. Function of BMPs as Intended: The Owner of each structural BMP installed shall maintain and operate it so as to preserve and continue its function in controlling stormwater quality and quantity as originally designed. Refer to Section 2.9, Inspection, Acceptance and Maintenance.

2.8.2 NCDENR BMP MANUAL

Designer is to refer to the NCDENR Stormwater Best Management Practices Manual, latest revision (http://portal.ncdenr.org/web/lr/bmp-manual), and this manual. Note that in any discrepancy between the NCDENR BMP Manual and the Town of Wake Forest Manual of Specifications, Standards and Design or the Unified Development Ordinance, the more stringent of the requirements apply.

2.8.3 DESIGN CONSIDERATIONS

A. Location

1. It is recommended that stormwater BMP facilities be located on the site from which the runoff to be controlled is generated. However, off-site facilities are acceptable in accordance with NCDENR regulations provided that the land area involved with the facility is delineated and officially recorded at the Wake County Register of Deeds office as a permanent "Stormwater BMP Easement." The property Owner on which the facility is located will also be required to submit to the Town a letter of commitment to the maintenance of the facility.

2. In no case shall a habitable structure be located within the BMP area of any stormwater storage facility. No utilities (sewer lines, power lines, water lines, etc.) shall be located within or immediately around any BMP facility.

B. Safety Considerations: Adequate safety measures such as warning signs, embankment slopes, fences, grates, and other features should be incorporated into the design of the facility wherever appropriate.

C. Proprietary BMP Systems may be allowed by the Town's Engineer in accordance with the specifications outlined by the NCDENR BMP Manual, Chapter 20, "Proprietary Systems." http://portal.ncdenr.org/c/document_library/get_file?uuid=2502eee0-339a-447d-90e2-79375c02f97b&groupId=38364.

2.8.4 STORMWATER DETAILS

Standard Details 9.50 through 9.76 are herein made part of this section by reference and should be utilized in conjunction with NCDENR's BMP Manual. The more restrictive shall apply.

2.9 INSPECTIONS, ACCEPTANCE & MAINTENANCE

2.9.1 LIMITS OF PUBLIC OWNERSHIP AND MAINTENANCE RESPONSIBILITY

A. All drainage easements carrying water from the right of way or public property shall be public and maintained by the Town of Wake Forest.

4. The Town of Wake Forest assumes no liability or responsibility for adjudicating disputes between property owners regarding non-publicly generated storm water.

B. Drainage systems maintained by NCDOT as part of its State highway system.

C. Detention/Retention/Water Quality Pond & Other BMP's: The Town will not accept these areas/structures for maintenance; however, the Town reserves the right to enter to routinely inspect these areas and address any items that would cause BMP(s) to be noncompliant. This will be done in an emergency situation without notice. Under normal conditions, the Town will contact the Owner/ developer to have said items addressed. If unable to do so within a reasonable time, the Town reserves the right to charge the Owner/developer for any expense incurred by the Town in doing so.

2.9.2 LIMITATION OF CONSEQUENTIAL DAMAGE TO PRIVATE FACILITIES LOCATED ON PUBLIC EASEMENTS

All public easements including storm sewer are to remain clear of obstructions. No buildings, fences, trees, shrubs or other obstructions shall be placed in any easement. Driveways, walkways, asphalt and parking lots may be permitted in easements; however, the Town reserves the right to remove such asphalt, concrete, base course and sod as necessary to access its facility in the case of emergency. Pavement or concrete will be replaced with a patch. Sod will be replaced with seeding like or similar grass. The Town will not be responsible for replacing a property owner's sod after repairing a drainage line.

2.9.3 ITEMS NEEDED FOR ACCEPTANCE

A. The following is required to be submitted prior to acceptance for each stormwater management BMP facility, control and device:

1. **Sealed As-Built drawings.** Refer to Section 2.9.3.B
2. **As-Built Certification by the Designer.** Refer to Section 2.9.3.C
3. **Operation and Maintenance Plan.** Refer to Section 2.9.3.D
4. **Legal Operation and Maintenance Agreement.** Refer to Section 2.9.3.E
5. **Performance Security for Installation and Maintenance.** Refer to Section 2.9.F

B. **Sealed as-built drawings** shall be submitted after final inspection and prior to acceptance, as follows:

1. Upon completion of a project, and **before a Certificate of Occupancy** shall be granted, the applicant shall certify that the completed project is in accordance with the approved stormwater management plans and designs, and shall submit actual field surveyed "as built" plans for all stormwater management BMP facilities or practices after final construction is completed.

2. The as-built plans shall be prepared by a professional land surveyor (PLS) or professional engineer (PE) registered to practice in North Carolina. Applicant to provide (2) sealed paper copies and (1) digital copy on CD (compact disk), consistent with the programs used by the Town of Wake Forest GIS Department. Field survey/ as-built to be tied to NC grid system.

3. The plans shall show the final design specifications for all stormwater management facilities and practices and the field surveyed contours, pipe size, pipe location, invert elevations and planted vegetation (if applicable) of all measures, controls, and devices, as installed. Detailed drawings for each stormwater control device shall be submitted to the Town's Engineer.

4. The as-built plans shall show all recorded drainage and access easements for each BMP, referencing book map and page number.

C. As-Built Certification

1. The Designer of the stormwater management measures and plans shall certify, under seal, that the as-built stormwater measures, controls, and devices are in compliance with the approved stormwater management plans and designs and with the requirements of this Manual.

2. Designer to provide a written statement bearing his seal stating that he has performed a thorough inspection of all required stormwater control facilities and that they are installed and performing in compliance with the approved stormwater control plan. Designers are to use the Town of Wake Forest **As-Built Certification Form,** *Form SW200,* found in Section 2.12 of this manual and online at: http://www.wakeforestnc.gov.

3. The following items must be inspected during and/or after installation of storm drainage lines and appurtenances, as applicable:

   a. All boxes and manholes for presence of weep holes, formed inverts, bolted down castings, pipe flushed against inside wall of box, steps and location of steps, proper corbeling of brick/block in accordance with the details and specs, wall thickness and depth of manhole.

   b. Pipe for cracks, pipe markings for compliance with specifications (painted and etched).

   c. Removal of debris and sediment in both pipe and box.

   d. Rip rap outlet protection and filter fabric, stilling basin compliance with plan

   e. Manhole casting cover reading "storm drainage."

   f. Armor protection of ditches (concrete and/or temporary liners), scour and erosion.

D. Operation and Maintenance Plan

1. For each type of BMP, provide description of BMP features requiring inspection, inspection frequency, types and frequencies of or basis for routine and periodic maintenance activities, actions in the event that repair is needed. Maintenance actions and frequencies shall at minimum include those identified by practice in the NCDENR BMP Manual. The Town of Wake Forest requires submittal of the Operation and Maintenance Agreement Forms provided in the NCDENR BMP Manual, online at:
   http://portal.ncdenr.org/web/lr/bmp-manual.

2. Name, address and contact telephone numbers of all current officers of the company or Owner's Association. Any changes in this information during the year shall be provided to the Town's Engineer within 30 days of the change.

3. For HOAs and other associations, description of method used to collect dues or other payments necessary for maintenance of BMPs.

4. Depending on the BMPs constructed the plan might include schedules or other provisions for:

   a. Any mowing of permanent vegetation.

   b. Any removal of bushes and trees from the dam of a wet detention pond.

   c. Reseeding of any eroding areas of the wet detention ponds, open channel practices, riparian buffers and vegetated filter strips.

   d. Replacing of impaired vegetation in a constructed wetlands or riparian buffer.

   e. Removal of debris from the "trash rack" on any wet detention pond or sand filter.

   f. Repair of any damage to structural aspects of wet detention ponds, constructed wetlands, level spreaders, and sand filters.

5. **Annual BMP Inspections Certification** is required on *Form SW210*, as described in Section 2.9.3.C.

E. Operation and Maintenance Legal Agreement

1. Prior to the conveyance or transfer of any lot or building site to be served by a required engineered stormwater, and prior to issuance of any permit for development requiring a engineered stormwater control pursuant to this ordinance, the applicant or Owner of the site must execute a **legal Operation and Maintenance agreement** that shall be binding on all subsequent owners of the site, portions of the site, and lots or parcels served by the engineered stormwater control. Until the transference of 80% of all property, sites, or lots served by the engineered stormwater control, the original owner or applicant shall have primary responsibility for carrying out the provisions of the maintenance agreement.

2. The legal Operation and Maintenance agreement shall require the owner or owners to maintain, repair and, if necessary, reconstruct the engineered stormwater control, and shall state the terms, conditions, and schedule of maintenance for the engineered stormwater control. In addition, it shall grant to the Town a right of entry in the event that the Town has reason to believe it has become necessary to inspect, monitor, maintain, repair, or reconstruct the structural BMP; however, in no case shall the right of entry, of itself, confer an obligation on Town to assume responsibility for the structural BMP.

3. The **Operation and Maintenance Agreement** must be approved by the Town prior to plan approval, and it shall be referenced on the final plat and shall be recorded with the county Register of Deeds upon final plat approval. A copy of the recorded maintenance agreement shall be given to the Town within 14 days following its recordation. An example Operation and Maintenance Agreement may be found in Section 2.12 of this manual and online at: http://www.wakeforestnc.gov.

4. The Operation and Maintenance agreement shall contain the following elements:

a. Annual Maintenance Plan

b. **Annual BMP Inspection Report**, per Section 2.9.3.C.

c. Contact Information

d. Authority

F. Performance Security for Installation and Maintenance:

1. The Town may, at its discretion, require the submittal of a performance security or bond with surety, cash escrow, or other acceptable legal arrangement prior to issuance of a permit in order to ensure that the engineered stormwater controls are:

   a. Installed by the permit holder as required by the approved stormwater management plan; and/or

   b. Maintained by the Owner as required by the operation and maintenance agreement.

2. In lieu of a performance security, bond, or cash escrow for Homeowner's Associations, the Town may, at its discretion, accept the Association's budget and other financial documentation that ensures that the Association will have sufficient finances for the installation and maintenance of the approved stormwater management plan. Such a decision will be made by the Town's Engineer on a case by case basis.

3. The amount of an installation performance security shall be in the amount of 110% of the cost estimate for the BMP. The performance bond may be reduced to 25% at the time the Certificate of Occupancy is issued to satisfy the requirement for the one year warranty period.

4. Within sixty days of the final approval, the installation performance security shall be refunded to the applicant or terminated, except any amount attributable to the cost (plus 25%) of landscaping installation and ongoing maintenance associated with the BMPs covered by the security. Any such landscaping shall be inspected one (1) year after installation with replacement for compliance with the approved plans and specifications and, if in compliance, the portion of the financial security attributable to landscaping shall be released.

5. The performance security shall contain forfeiture provisions for failure, after proper notice, to complete work within the time specified, or to initiate or maintain any actions which may be required of the applicant or Owner in accordance with this ordinance, approvals issued pursuant to this ordinance, or an operation and maintenance agreement established pursuant to this ordinance

6. Upon default of the *Owner* to construct, maintain, repair and, if necessary, reconstruct any engineered stormwater control in accordance with the applicable permit or operation and maintenance agreement, the Town shall obtain and use all or any portion of the security to make necessary improvements based on an engineering estimate. Such expenditure of funds shall only be made after requesting the Owner to comply with the permit or maintenance agreement. In the event of a default triggering the use of installation performance security, the Town may not return any of the unused deposited cash funds or other security.

7. If Town takes action upon such failure by the applicant or Owner, the Town may collect from the applicant or Owner the difference between the amount of the reasonable cost of such action and the amount of the security held, in addition to any other penalties or damages due.

G. A final inspection and approval by the Town's Engineer may be required before the release of any performance securities.

H. Signage: Where appropriate in the determination of the Town of Wake Forest to assure compliance with the MSSD and Unified Development Ordinances, structural BMPs shall be posted with a conspicuous sign stating who is responsible for required maintenance and annual inspection. The sign shall be maintained by the Owner so as to remain visible and legible.

2.9.4 SPECIAL REQUIREMENTS FOR HOME OWNERS AND OTHER ASSOCIATIONS

For all structural BMPs required pursuant to this manual and that are to be or are owned and maintained by a homeowners' association, property owners' association, or similar entity, the required operation and maintenance agreement shall include all of the provisions described in the Unified Development Ordinance, Section 12.5.6.F.

2.9.5 MAINTENANCE

The long-term effectiveness of any engineered stormwater control relies, above all, on appropriate maintenance. This section provides provisions to ensure that such maintenance occurs, including identifying who will be responsible for maintenance over the long term as well as during development, and ensuring that funds for maintenance and repair are available when appropriate. The Town is required to ensure that BMPs implemented to achieve nutrient reduction and flow attenuation requirements are maintained and inspected on a yearly basis.

A. Function of BMP as Intended: The Owner of each engineered stormwater control installed pursuant to this ordinance shall maintain and operate it so as to preserve and continue its function in controlling stormwater quality and quantity at the degree or amount of function for which the engineered stormwater control was designed.

B. Records: Records of maintenance and/or repair activities shall be maintained by the Owner for at least 5 years and shall be provided to the Town upon request.

C. Annual Inspection:

The person responsible for maintenance of any required engineered stormwater control shall submit to the Town's Engineer an annual inspection report from one of the following persons performing services only in their area of competence: a qualified registered North Carolina professional engineer, surveyor, landscape architect, soil scientist, aquatic biologist, or person certified by the North Carolina Cooperative Extension Service for stormwater treatment practice inspection and maintenance.

1. The inspection report shall contain all of the following:

    a. The name and address of the land owner;

    b. The recorded book and page number of the lot of each engineered stormwater control;

    c. A statement that an inspection was made of all engineered stormwater controls;

    d. The date the inspection was made;

e. A statement that all inspected engineered stormwater controls are performing properly and are in compliance with the terms and conditions of the approved maintenance agreement required by this ordinance; and

f. The signature and seal of the engineer, surveyor, or landscape architect.

g. A narrative describing the general condition of the site.

h. A narrative for each BMP that describes in detail its current condition.

i. Photographs to document sufficiently the current condition of all structures and features.

2. Special attention should be made to the following items, which should be discussed in the narratives for each BMP:

   a. Has sediment built up in the inlet, outlet, or forebay?

   b. Are there signs of erosion or any denuded areas?

   c. Is there trash or debris that needs to be removed? (This is particularly important at outlet structures.)

   d. Are algae, aquatic weeds, or invasive plants (particularly cattails) present?

   e. Is there evidence of cracks, separation, or alignment problems with pipes?

   f. Are rip-rap dissipator pads damaged, clogged with vegetation, or insufficient?

   g. For dry detention ponds, is the basin holding water longer than 5 days after a storm event

   h. Is there evidence of muskrat or beaver activity?

   i. Are vegetated slopes steeper than 3:1?

   j. Is there evidence of depressions in the soil surface over or around any pipes?

3. **Failed Inspection:** If the BMPs have major deficiencies (system failure) and must be repaired in order to function properly and operate as designed, the Annual BMP Inspection Report form and supporting documentation must be completed by the deadline, but the registered professional is not obligated to sign and seal the form.

   a. The Owner is responsible for correcting all deficiencies identified in the report, obtaining a re-inspection following repairs, and submitting a revised Annual BMP Inspection Report, **within 30 days** after the deadline.

4. **Conditional Approval:** If the BMPs have minor deficiencies (system operates, but repair is needed to ensure the system does not fail), the Annual BMP Inspection Report form and supporting documentation must be completed by the deadline, but the registered professional is not obligated to sign and seal the form.

   a. The Owner is responsible for correcting all deficiencies identified in the report, obtaining a re-inspection following repairs, and submitting a revised Annual BMP Inspection Report, **within 30 days** after the deadline.

5. **Annual BMP Inspection Report Form:** All inspection reports shall be on forms supplied by the Town. An original inspection report shall be provided to the Town's Engineer prior to January 1 of each year. The Town of Wake Forest **Annual BMP Inspection Report Form,** *Form SW210,* is found in Section 2.12, Appendix, and online at: http://www.wakeforestnc.gov.

2.9.6 WARRANTY

A. Warranty and Defects Guarantee:

1. Upon the acceptance of facilities, utilities or streets for permanent maintenance, a one-year warranty for all improvements shall become effective. This warranty must be satisfactory to the Town of Wake Forest. In addition, the subdivider shall provide surety in the amount of 15% of the total construction cost to guarantee the correction of all defects in such facilities, utilities or streets that occur within the warranty period described above.

2. For the purposes of this section, the term "defects" refers to any condition in publicly dedicated facilities, utilities or streets that requires the Town to make repairs to such improvements over and above the normal amount of maintenance that they would require. If such defects appear, the warranty may be enforced regardless of whether the facilities, utilities or streets were constructed in accordance with the requirements of this manual.

B. During the one-year warranty period the developer shall repair any latent defects which occur. At the end of the one-year warranty period the developer shall request a final inspection. Upon successful completion of all warranty items the developer shall be released from maintenance responsibilities for the warranted construction.

C. Warranty repairs to the following common problems shall be as follows:

1. Water & Sewer Trench Failures: Street pavement trench failures shall be repaired in accordance with the City of Raleigh Public Utilities Handbook.

2. Storm Drainage & Other Utility Trench Failures: Street pavement trench failures shall be repaired in accordance with Standard Detail 9.06.

3. If more than 3 trench failures occur within a longitudinal distance of 800 feet on any segment of a street, the Town shall require a 1-inch overlay once repairs have been completed.

4. Cracks in sidewalk and/or curb and gutter shall be repaired by removing and re-pouring such sections as necessary;

5. All storm sewer systems, ditches and gutters shall be free of debris, dirt or silt;

6. All drainage and street appurtenances shall be in perfect condition and properly exposed.

7. All other defects shall be corrected in accordance with the recommendations of the Town's Engineer or his representative;

D. If a developer fails to complete warranty items, future projects of the developer shall not be reviewed by the Town. The Town may take additional legal action against the developer.

2.9.7 INSPECTION PROGRAM

A. Inspections and inspection programs by the Town of Wake Forest may be conducted or established on any reasonable basis, including but not limited to

routine inspections; random inspections; inspections based upon complaints or other notice of possible violations; and joint inspections with other agencies inspecting under environmental or safety laws. Inspections may include, but are not limited to, reviewing maintenance and repair records; sampling discharges, surface water, groundwater, and material or water in BMPs; and evaluating the condition of BMPs.

B. If the Owner or occupant of any property refuses to permit such inspection, the Administrator shall proceed to obtain an administrative search warrant pursuant to NCGS 15-27.2 or its successor.

C. All inspections must be scheduled the day prior to when needed. Inspections will be performed in the order received. Every effort will be made to accommodate the time of request, however, this cannot be guaranteed.

D. All inspections that fail are subject to a re-inspection fee according to the Town's Comprehensive List of Fees and Charges.

E. Upon completion of construction the developer shall request a warranty inspection. Upon completion of all punch list items, the provision of a set of acceptable record drawings, and the submission of engineer's certifications, a one-year warranty period shall commence.

2.9.8 FAILURE TO COMPLY

Any violation of the Maintenance agreement shall be considered a violation of the Unified Development Ordinance and shall be enforced in accordance with the Town of Wake Forest UDO. In addition, if the situation meets the definition of a nuisance as defined in NCGS 153A-140 other corrective actions may be taken.

2.10 PIPE POLICY – MATERIAL / INSTALLATION

All materials and installation procedures, testing and acceptance of all publicly dedicated drainage infrastructures shall meet the requirements of the Town of Wake Forest Manual on Specifications and Design.

2.10.1 PURPOSE AND DEFINITION

The purpose of this policy is to establish a written standard on the type of pipe to be used in a ditch or tributary carrying storm water run-off from a dedicated public street or from property owned and maintained by the Town (herein "public water") which is either subject to review, maintenance or inspection by the Town or located within either the Town limits of Wake Forest or under its extraterritorial jurisdiction.

2.10.2 PIPE MATERIAL

A. Storm drainage pipe, covered by the definition in paragraph 2.10.1 of this section, shall be reinforced concrete pipe except for the following exemption:

1. Pipe is 12" I.D. or smaller, made of plain concrete, and is to be used in residential drives or roadside ditches. The Town of Wake Forest Engineering staff will determine the size required.

2. Corrugated metal arch pipe may be used where head room, fill and flow conditions of the tributary warrant it with the approval the Town of Wake Forest Engineering staff.

B. All concrete pipe to be used shall be either etched "***RC X***" (where ***X*** represents the class pipe) **<u>or</u>** marked visibly and legibly according to the following:

1. Stamp location: spigot end of pipe on inside.

2. Stamp size stenciled letters: 1-1/2" in height minimum.
3. Code Class 3 Reinforced Concrete: TWF-RC-3
4. Code Plain Concrete: TWF-P
5. Stamp color: fluorescent orange or red.

Unmarked pipe will be allowed only if the manufacturer furnishes a certified statement on the entire shipment and etchings are placed on each pipe joint.

Table 2.23 Storm Drainage Pipe Policy

Location on Drainage Course	Type of Pipe	Installation Requirements	Maintenance Responsibility	Who Pays Pipe & Material Costs	Who Pays Installation Cost
Driveway	RCP or Plain if diameter is 12" ID or under	Owner sets grade, Town checks grade and owner meets conditions of driveway permit	Town will maintain clear flow – owner replaces if pipe is damaged beyond use	Property Owner	Property Owner
Roadside Ditch	RCP or Plain if diameter if 12" ID or under	Per Section 2.10.3, Pipe Policy	Town will maintain clear flow – owner replaces if pipe is damaged beyond use	Town except in new Subdivision developments	Town except in new subdivision developments
Cross Street Culverts	RCP, Reinforced Concrete Box Culvert	Set by Town Public Works & Utilities Director	Town	Town except in new Subdivisions developments	Town except in new subdivision developments
Off Right-of-way Ditches (carrying public water)	RCP, Double Walled Corrugated HDPE, Conc. Lined channels, gabions, or other approved structure	Set by Town Public Works & Utilities Dir., Storm Drainage Policy, Subdivision Reg., if new development.	Town if installed by the Town pursuant to street drainage policy.	Property Owner	Town if installed under storm drainage policy
			Town if installed by developer under subdivision reg. and accepted by Town.		Owner if installed according to subdivision reg.
Note: All construction and installation of storm drainage structures is subject to the Manual of Specifications, Standards and design of the Town of Wake Forest and the approval of the Town of Wake Forest Engineering staff.					

2.10.3 PLACEMENT OF ROADSIDE DITCH PIPE

The following will apply on all concrete pipe installed in a roadside ditch were the ditch serves the function of draining the roadbed:

A. Bedding shall be in conformity with paragraph 2.4.6.L, which also stipulates that all but the bottom 2-inch of the pipe joint (as measured across the diameter of the pipe) shall be sealed in accordance with Technical Specification 02700, Storm Drainage, paragraph 3.3.B, "Bedding Rigid Pipe."

For rigid pipe, refer to Standard Detail 9.53 for depth of bury and bedding requirements.

B. All grades will be set by the Owner and checked by the Town.

C. The property Owner must apply for a permit and bear cost of installation.

D. Pipe cover shall be a minimum of 6-inches.

2.10.4 PLACEMENT OF OTHER PIPE

All other bedding of storm culverts shall be according to the Technical Specifications.

2.11 APPLICATION PROCEDURE

Application for storm drainage improvements shall be made on forms available from the Public Works and Utilities Department (see sample form below).

Figure 2.16 Sample Storm Drainage Application Form

APPLICATION FOR STORM DRAINAGE PARTICIPATION TO THE DEPARTMENT OF PUBLIC WORKS AND UTILITIES OF THE TOWN OF WAKE FOREST:

The undersigned (the Applicant, whether one or more) hereby makes application to the Town of Wake Forest (the Town) to participate with the Applicant under principles set forth in the Town's Policy regarding installation of storm drainage on private property (the Policy) in the installation of a storm drain crossing the property of the Applicant at:

_____

within the Town corporate limits, and herewith delivers to the Town the non-refundable sum of $50 to cover the Town's cost of processing this Application, which sum the Applicant understands is non-refundable. If the Town constructs the project, the application fee shall apply to the property Owner(s) cost. The Applicant does hereby represent as follows:

1. The Applicant has read and is familiar with the Town's Policy, and storm drain, if installed, will carry storm drainage water discharged from an existing Town street or Town streets.
2. The proposed storm drain, if installed, is to be installed in accordance with specifications as approved by the Town.
3. The Applicant acquired ownership to the property on which the proposed storm drain and the proposed easement is to be located as follows:

NOTE: ALL OWNER(S) MUST SIGN!

GRANTOR/GRANTEE		DATE OF DEED	RECORDED	
			BOOK	PAGE NO.
1				
2				
3				
4				
5				
6				
7				
8				

4. In the event the Town agrees to participate with the Applicant in the installation of said proposed storm drain, then prior to such participation the Applicant will execute and deliver to the Town such necessary perpetual easement as specified by the Department of Public Works and Utilities for the installation and maintenance of said proposed storm drain, which easement shall incorporate the terms and conditions under which said storm drain is to be installed and the basis on which the Town shall participate therein.

This _____ day of _____, 20_____
Signature of Applicant(s): (If corporation, must be executed in corporate name by an officer).

_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

Certified and approved by the Department of Public Works and Utilities.

_____ _____
Director of Public Works and Utilities Date

2.12 STORMWATER APPENDIX

A. **Stormwater Management Permit Application/ Low Density Supplement Form**
Use latest "State Stormwater Permit Application" forms from NCDENR website:
http://portal.ncdenr.org/web/lr/state-stormwater-forms_docs

B. **Stormwater Management Checklist,** *Form SW110*

C. **Example Stormwater Operation And Maintenance Agreement**

D. **As-Built Certification Form,** *Form SW200*

E. **Annual BMP Inspection/ Certification Form,** *Form SW210*

TOWN *of*
WAKE FOREST

STORMWATER MANAGEMENT CHECKLIST

This signed checklist should be submitted with the Stormwater Management Plan.

Project Name: Click here to enter text.

Site Address: Click here to enter text. PIN No: Click here to enter text.

Owner/Developer: Click here to enter text.

Plans are to include:

☐	**Vicinity map** showing the location of the site within the Town limits. The scale of the map shall be adequate to show the area in question with reasonable depiction of streets to determine the exact location of the site. The minimum scale shall be no less than 1"=400'.
☐	**Overall map** of the site showing the current zoning and land use of adjacent property, which could be affected by the proposed stormwater management system.
☐	**Existing topographical information** for the site with a minimum of 2-ft contours.
☐	**100-year Flood Plain** boundaries and elevations from the latest FEMA FIRM map.
☐	**Wetlands** boundaries as verified with the US Corps of Engineers.
☐	**USGS Quadrangle Map**, properly labeled with project location and riparian buffers.
☐	**Wake County Soils Survey Map**, properly labeled with project location and Neuse Riparian Buffers. Please note that the soil survey map must be from the hard copy and not from the NRCS website.
☐	**Stormwater management features**, both existing and proposed.
☐	**Details** of all proposed stormwater management structures. The detail shall be sufficient to provide information to construct and review the structure for proper design.
☐	**Easements** for all stormwater management structures.
☐	**Profiles** for proposed stormwater structures to include the storm drainage systems. This can be included with road profiles or can be separated to for clarity. The stormwater profiles must show the existing and proposed ground elevations, the structure information (such as top elevation and sump elevation), and the design storm water elevation and profile.
☐	**Construction sequence** for the construction of the stormwater management structures to specifically include the timing of when to install the system. This can be part of the erosion and sedimentation control construction sequence.
☐	**Landscape plan**, which clearly shows the extent of undisturbed vegetation and the location, species, number and planting characteristics (including height at time of planting, spacing, etc.) of proposed vegetation. The plan must also describe the vegetative stabilization and management techniques to be used at the site after construction is completed, who will be responsible for the maintenance of vegetation, and what practices will be employed to ensure that adequate vegetation cover is preserved.

Stormwater Calculations:

☐	**Drainage maps** for the area of development. Both overall and site-specific drainage maps are required to give an accurate picture of the water flow.
☐	**Calculations** and analysis of stormwater drainage system.
☐	**Calculations** of Pre- vs. post-development runoff
☐	**Calculations** for nutrient removal, if necessary
☐	**Calculations** of Best Management Practices (BMPs) including hydrographs, storage calculations, buoyancy calculations, etc.
☐	**Analysis** of the stormwater runoff impacts that the proposed development or construction activity will have on the surrounding properties, both upstream and downstream.

Submittals:

☐	(1) Stormwater Management Checklist
☐	(1) Stormwater Management Permit Application. See Appendix A.
☐	(1) Full set of plans for the entire development
☐	(2) Stormwater Management Plan and Details
☐	(2) Stormwater Calculations
☐	(2) Stormwater Operations and Maintenance Agreement (draft). See Appendix C.
☐	(2) Stormwater Operations and Maintenance Plan (draft). See Appendix D.
☐	NCDENR DWR/ COE, if required.

Submitted By:_____ Date:_____

Signature:_____

NORTH CAROLINA

COUNTY OF WAKE

TOWN OF WAKE FOREST
STORMWATER CONTROL FACILITIES/BMPs
OPERATION AND MAINTENANCE
AGREEMENT

THIS AGREEMENT (the "**Agreement**"), is hereby made and entered into this _____day of _____, 202___ (the "**Effective Date**"), by and between _____, a _____, (the "**Permittee**") and the Town of Wake Forest, a North Carolina municipal corporation (the "**Town**").

W I T N E S S E T H:

WHEREAS, the Town has adopted through the Unified Development Ordinance certain stormwater management regulations applicable to the property owned by Permittee located in the Town of Wake Forest, North Carolina and known as _____ (the "**Property**"), a legal description of which Property is attached hereto as Appendix A and incorporated herein by reference; and

WHEREAS, such stormwater management regulations, including but not limited to the Town of Wake Forest Unified Development Ordinance, Chapters 6, 12 and 15, as may be amended, modified, or supplemented from time to time (collectively, the "**SCM Regulations**"), require the Permittee to provide for, operate and maintain engineered stormwater control measures and stormwater treatment practices, also referred to as Best Management Practices, or BMPs (collectively, "**SCMs**"), to control the adverse effects of increased post-development stormwater runoff and nonpoint and point source pollution associated with new development and redevelopment; and

WHEREAS, to satisfy the requirements of the SCM Regulations, Permittee has constructed, or intends to construct, certain SCMs serving the Property, or portions of the Property (the "**Facility**" or "**Facilities**"), the boundaries and general description of such Facilities being described in Appendix B attached hereto and incorporated herein by reference; and

WHEREAS, Permittee is required to operate and maintain the Facilities in accordance with the SCM Regulations and all other applicable laws; and

WHEREAS, the SCM Regulations further require Permittee to enter into this Agreement prior to the conveyance or transfer of any lot or building site to be served by the Facilities, and prior to issuance of any permit for development or redevelopment requiring the Facilities; and

NOW, THEREFORE, for and in consideration of the premises and the approval by the Town of the development activities on the Property, the Permittee does hereby covenant and agree with the Town that the

Property and Facilities shall be held, operated, maintained, and encumbered pursuant to the covenants and conditions hereinafter set forth.

1. Primary Responsibility. Notwithstanding anything herein to the contrary, Permittee covenants and agrees that it will not convey, transfer, assign, lease, or otherwise release or relinquish ownership or control of the Facilities, in whole or in part, (referred to herein as a "**conveyance**"), including a conveyance to an Association (as defined in Section 4), until Final Acceptance (as defined in Section 2) has occurred. Once Final Acceptance has occurred, a conveyance of the Facilities shall be permitted (i) upon prior written notice thereof to the Town, and (ii) provided that any such transferee or assignee assumes all obligations under this Agreement. Once a conveyance has occurred in accordance with this Section, all references herein to "Permittee" shall be deemed to refer to such permitted transferee or assignee.

2. Final Acceptance. Upon completion of the Facilities, Permittee shall request an initial warranty inspection from the Town. Once the Facilities pass the initial warranty inspection ("**Initial Acceptance**"), as determined by the Town in its sole and reasonable discretion, the Permittee shall submit the following to the Town:

(a) A set of acceptable as-built drawings; and

(b) A written warranty against defects which shall guarantee the material and workmanship of the Facilities for a period of not less than one (1) year from the date that both Initial Acceptance and the Town's receipt of the as-built drawings required by subsection (a) has occurred (the "**Warranty Period**").

Upon the expiration of the Warranty Period, Permittee shall request a final inspection of the Facilities by the Town. Until such time that the Facilities pass final inspection ("**Final Acceptance**"), as determined by the Town in its sole and reasonable discretion, Permittee shall have primary responsibility for carrying out the provisions of this Agreement.

3. Operation and Maintenance. Permittee shall operate, maintain, repair, and, if necessary, reconstruct the Facilities in accordance with the provisions below:

(a) Maintenance of the Facilities shall be at least in accordance with the minimum standards and instructions for the specific type of SCMs, as set forth in the NCDEQ Stormwater Design Manual, including any and all subsequent revisions thereto (the "**Manual**").

(b) Beginning one (1) year from the date of as-built certification and each year thereafter on or before the date of the as-built certification, or such other date as mutually agreed to by the parties herein, Permittee shall submit to the Town for its review and approval: (i) a certification, sealed by a certified inspector, that an inspection of the Facilities has been performed and that the Facilities are functioning as intended; and (ii) a certification by the Permittee that (1) all required maintenance activities have occurred in accordance with this Agreement and the SCM Regulations; (2) all necessary non-routine maintenance has been listed and performed, if any; and (3) the *Operation and Maintenance Plan* is adequate to ensure optimal functioning of the Facilities, or that changes are recommended (collectively, the "**SCM Certification**").

(c) An *Operation and Maintenance Plan* shall be signed by the Permittee and submitted to the Town prior to approval of this Agreement. Changes to the *Operation and Maintenance Plan* shall be submitted with the *SCM Certification*, if required to maintain optimal functioning of the Facilities or to remain in compliance with the maintenance recommendations of the Manual. Proposed changes to the *Operation and Maintenance Plan* are subject to approval by the Town. Additional information may be required for reporting purposes, as directed by the Town Engineer or designee.

(d) Landscaping of the area around the Facilities shall not reduce the capacity or hinder operation and maintenance of the Facilities. Landscaping shall be maintained to ensure that landscape materials live and prosper. Re-vegetation and stabilization of areas may be required by the Town Engineer or designee. Notwithstanding the foregoing or anything herein to the contrary, Permittee shall be permitted

to assign its landscaping maintenance responsibilities to an Association (as defined herein below) prior to Final Acceptance.

(e) The Facilities shall be maintained in a manner so as to control insects, odors and algae as determined necessary by the Town Engineer or designee.

(f) Any fencing, or other safety and security measures, shall be maintained in good condition. If no fencing, or other safety and security measures, are included with the original construction, then such measures shall be added at the Permittee's expense and at such time as the Town Engineer or designee reasonably determines that such safety and security measures are necessary. Safety and security measures may include, without limitation, warning signs, fences, grates, and other similar features.

(g) Necessary non-routine maintenance actions shall be performed in a timely manner so as to ensure continuous performance of the Facilities. All non-routine maintenance activities shall be noted in the annual SCM Certification.

4. Requirements for Conveyance to an Association. In addition to all other terms and conditions set forth in this Agreement, any conveyance of the Facilities, in whole or in part, to any homeowner's association, property owner's association, or similar entity ("**Association**") shall be subject to the following terms and conditions:

(a) Prior to any conveyance of the Facilities from the Permittee to an Association, Permittee shall revise, if not already addressed therein, the *Operation and Maintenance Plan* to include an estimated annual maintenance budget for the Facilities.

(b) Upon conveyance of the Facilities from the Permittee to an Association, such Association shall continuously operate and maintain the Facilities in accordance with this Agreement and the SCM Regulations.

(c) If the Facilities are not performing adequately or as intended or are not properly maintained by the Association, the Town may remedy the situation, and in such instance the Town shall be fully reimbursed by the Association and its members within thirty (30) days of the Town's request thereof. The Town shall be permitted to recover from the Association and its members any and all costs the Town expends to maintain or repair the Facilities or to correct any operational deficiencies. Failure to pay the Town all of its expended costs, after thirty (30) days written request thereof, shall constitute a breach of this Agreement. The Town shall thereafter be entitled to bring an action against the Association and its members to pay, or foreclose upon, the lien hereby authorized by this Agreement against the Property, or both, in case of a deficiency. Interest, collection costs, and attorney fees shall be added to the recovery.

Notwithstanding the foregoing or anything herein to the contrary, under no circumstances shall conveyance to an Association occur until such time that Final Acceptance has occurred.

5. Right of Inspection by Town. The Permittee hereby grants the Town the right, privilege and easement over, upon and across the Property lying between any public street or right of way and the Facilities for the purpose of inspecting, monitoring, correcting, repairing, replacing, reconstructing, or maintaining the Facilities as provided in this Agreement; however, in no case shall the right of entry, of itself, confer an obligation on the Town to assume responsibility for the Facilities, or any portion thereof. This right, privilege and easement is appurtenant to and shall run with the Property and the Facilities.

6. No Liability. Notwithstanding anything herein to the contrary, under no circumstances shall the Town be obligated to maintain or repair the Facilities, nor shall the Town be liable to any person for the condition or operation of the Facilities. In addition, the Permittee shall indemnify and hold harmless the Town for any costs and injuries arising from or related to the Facilities, unless the Town has agreed in writing to assume maintenance responsibility for the Facilities and has expressly accepted dedication of any and all rights necessary to carry out that maintenance.

7. Remedies for Violations of this Agreement.

(a) If the Permittee shall fail to satisfactorily maintain or repair the Facilities as set forth herein, or otherwise violates this Agreement, the Town may order the Permittee to undertake necessary actions to correct such violation. If the Permittee fails to comply with such order within (30) days from the date thereof, the Town, in its sole discretion, may enter the Property and perform all necessary work to place the Facilities in proper working condition. The full cost of performing the work shall be a lien on the Property as provided in N.C.G.S. § 160A-193. In such event, the Town shall assess against Permittee all of its related costs and expenses (including but not limited to employee time, materials and supplies, vehicle and equipment use, administrative expenses, plus all contract costs, if required for repairs, design or inspection) and the Permittee hereby agrees to timely pay the same. Where the Permittee is the sole owner of the development, if this total amount is not paid in full within three (3) months of the assessment, then such amount shall be a continuing lien on the Property. Where there is more than one owner of record of the Property, and if the total amount is not paid in full to the Town within three (3) months of the assessment, then each owner of record shall become personally liable for such owner's proportionate share of the assessment. If the proportionate share of the assessment is not paid in full by each such owner within thirty (30) days following receipt of notice thereof from the Town, then such amount shall be a continuing lien on the property owned by each owner, such owner's heirs, devisees, personal representatives, successors and/or assigns.

(b) The Town shall have the right to bring an action against the Permittee and/or each individual owner to recover all sums due, including its expenses, damages and its reasonable attorney fees, seek injunctive and equitable relief, and/or such other and further relief as may be just and appropriate.

(c) The remedies provided by this paragraph are cumulative and are in addition to any other remedies provided by law.

8. Municipal Authority. Nothing contained in this Agreement shall in any way diminish, limit, or restrict the right of the Town to enforce any of its ordinances as authorized by law.

9. No Waiver of Breach. In the event of a breach of any term of this Agreement, any delay or failure on the part of the Town to exercise any rights, powers, or remedies herein provided shall not be construed as a waiver thereof or acquiescence of such breach or any future breach.

10. Amendments. This Agreement may be amended, revised or modified only by a written document signed by the parties.

11. Binding Effect. The conditions and restrictions set forth herein with regard to the Facilities shall run with the land and shall bind the Permittee and its heirs, successors and assigns and all parties claiming by, through, or under them shall be taken to hold, agree, and covenant with the Town, its successors and assigns, and with each of them to conform to, comply with and observe said conditions and restrictions. The Town shall be deemed a beneficiary of the conditions and restrictions set forth herein and such conditions and restrictions shall run with the land in favor of the Town.

12. Warranties of Title. The Permittee covenants and warrants that it is lawfully seized and possessed of the Property described in Appendix A as well as the Facilities described in Appendix B, that it has good right and lawful authority to enter into this Agreement for the purposes herein expressed, and that no consent or waiver by the holder of any mortgage, deed of trust, or other security instrument, or any other person, firm, or corporation is required prior to entering into this Agreement.

13. Interpretation and Governing Law. Use of the masculine gender herein includes the feminine and neuter, and the singular number used herein shall equally include the plural. The captions preceding the various

provisions of this Agreement are for convenience of reference only, and shall not be used as an aid in interpretation or construction of this Agreement. The laws of North Carolina shall govern this Agreement.

14. Severability. Invalidation of any one of these covenants or conditions by judgment or order of any court shall in no way affect any of the other provisions, which shall remain in full force and effect.

15. Recording. This Agreement shall be recorded by the Permittee in the Wake County Register of Deeds Office (i) in the case of a site plan, as a condition of final issuance of a Certificate of Occupancy, or (ii) in the case of a subdivision, as a condition of final plat approval. In any event, this Agreement shall be recorded in the Wake County Register of Deeds Office so as to appear in the chain of title of all subsequent purchasers of the Property, or any portion thereof. Failure to record this Agreement in compliance with Section 12.5.6 of the Wake Forest UDO shall constitute a stormwater violation subject to penalties as further set forth in Section 16.3.5 of the Wake Forest UDO.

[Remainder of Page Intentionally Blank. Signature Page Follows.]

IN WITNESS WHEREOF, the Town and the Permittee have hereunto set their hands and seals as of the Effective Date.

THE TOWN

The Town of Wake Forest,
a North Carolina municipal corporation

By: _____
Name: _____
Title: _____

STATE OF NORTH CAROLINA

COUNTY OF WAKE

I, _____, a notary public in and for said county and state, certify that _____ (Name) personally appeared before me this day, stated that he or she is the _____ (Title) of the Town of Wake Forest, a political Township in the State of North Carolina, and that by authority duly given may act on behalf of the Town.

This the _____ day of _____, 202__.

_____
Notary Public

My Commission Expires: _____

(SEAL)

THE PERMITTEE

_____,
a _____

By: _____
Name: _____
Title: _____

STATE OF _____

COUNTY OF _____

I, _____, a notary public in and for said county and state, certify that _____ personally appeared before me this date and acknowledged that he (or she) is _____ (title) of _____ (entity), a _____ (type of entity), and that he (or she) as _____ (title), being authorized to do so, executed the foregoing on behalf of said entity.

Witness my hand and official seal, this the _____ day of _____, 202__.

_____
Notary Public

My Commission Expires: _____

(SEAL)

Appendix A

Legal Description of the Property

Being all of the Property known as _____, recorded in Book _____ Page _____, Wake County Registry.

Note:

- *If the whole subdivision is not being recorded at the same time, (i) indicate the recorded sections, and (ii) specify any and all future sections to be developed as part of the preliminary plat approved by Wake County on _____.*
- *For phased final plats, all plats recorded after this Agreement or any other applicable agreements must include a note on the plat stating that the property on that plat is subject to the agreements recorded previously (with DB/Page records).*

Appendix B

Description of the Facilities (SCMs)

All stormwater control measures located on the Property and identified as _____, as approved by the Town of Wake Forest on_____, are more particularly identified as:

Example:

BMP #1: Dry Detention Pond #1*, located on Lot # ___ or special Lot for stormwater conservation located adjacent to Lot # ___.*

BMP #2: Bioretention Area #1*, located on Lot # ___ or special Lot for stormwater conservation located adjacent to Lot # ___.*

TOWN *of*
WAKE FOREST

STORMWATER BMP AS-BUILT CERTIFICATION FORM

This completed certification and accompanying materials are to be submitted to the Town Engineer prior to issuance of Certificate of Occupancy. Sealed as-built drawings as described in the Manual of Specification, Standards and Design, Section 2.10.3B, are required for each stormwater control device.

Project Information:

Project Name:	
Property Address:	
Property Owner:	
Property Owner Address:	
Property Owner Email:	Telephone:
Wake County PIN:	Date of Inspection:

BMP Description and Quantity *(designate all that apply)*

_____ Dry Detention Basin	_____ Sand Filter	_____ Grassed Swale	_____ Cistern
_____ Wet Detention Basin	_____ Level Spreader	_____ Permeable Pavement	_____ Underground Storage/Detention
_____ Stormwater Wetland	_____ Bioretention Area	_____ Proprietary Devices/ Other:	_____

Engineer, Surveyor or Landscape Architect Certification:

As a duly registered professional in the State of North Carolina, I hereby attest that all required stormwater control facilities system for the above referenced project were inspected under my responsible charge, and to the best of my knowledge the construction, safety and function are in compliance with the intent of the approved plans and the Town of Wake Forest and NCDENR standards and regulations.

Certifier's Name:	License Number:
Title:	Company Name:
Address:	City/ State/ Zip:
Telephone:	Email:

Seal/ Signature/ Date

TOWN *of*
WAKE FOREST

STORMWATER BMP ANNUAL INSPECTION REPORT

This completed certification and accompanying materials are to be submitted to the Town Engineer each year by the anniversary of the initial as-built certification date, as described in the Manual of Specification, Standards and Design, Section 2.10.C, are required for each stormwater control device.

Project Information:

Project Name:	
Property Address:	
Property Owner:	
Property Owner Address:	
Property Owner Email:	Telephone:
Wake County PIN:	Date of Inspection:
Recorded Book and Page Number for each required stormwater control facility:	Book/ Page:

BMP Description and Quantity *(designate all that apply)*

_____ Dry Detention Basin	_____ Sand Filter	_____ Grassed Swale	_____ Cistern
_____ Wet Detention Basin	_____ Level Spreader	_____ Permeable Pavement	_____ Underground Storage/Detention
_____ Stormwater Wetland	_____ Bioretention Area	_____ Proprietary Devices/ Other:	_____

Information for All BMPs:

Additional pages are required to complete this Stormwater BMP Annual Inspection Report. A narrative for each BMP is to be provided that details the current condition. Photographs are to be included to document sufficiently the current condition of all structures and features.

Engineer, Surveyor or Landscape Architect Certification:

As a duly registered professional in the State of North Carolina, I hereby attest that all required stormwater control facilities for the above referenced project were thoroughly inspected under my responsible charge, were found to be performing properly and were in compliance with the approved stormwater management plan, applicable operation and maintenance agreements, and the Town of Wake Forest and NCDENR standards and regulations.

Certifier's Name:	License Number:
Title:	Company Name:
Address:	City/ State/ Zip:
Telephone:	Email:

Seal/ Signature/ Date

3 STREET DESIGN

(Rev 3/09/15)

3.1 INTRODUCTION

The following section has been established to assist developers and engineers with the design of streets (private and public) within the jurisdiction of the Town of Wake Forest. The methods, procedures, design factors, formulas, graphs, and tables presented in this division are intended to establish minimal guidelines for residential and commercial pavement design. The Town of Wake Forest believes that the following design criteria are sufficient to ensure the welfare and safety of the general public and to protect the economic investment of the citizens of our Town.

Alternative design methods may be considered by the Engineer/Designer on a case-by-case basis, however, there should not be extensive variations from the criteria and procedures within this division without the expressed approval of the Director of Engineering.

3.1.1 TOWN OF WAKE FOREST TOWN'S ENGINEER

The Town of Wake Forest Engineering staff shall be responsible for interpretation and implementation of the pavement design criteria for the Town of Wake Forest. Approval from other applicable agencies may be required.

3.1.2 TOWN OF WAKE FOREST PAVEMENT POLICY

It is the policy of the Town of Wake Forest that all developed land within the Town Limits have adequate streets and parking lots. The Town may accept roadway systems for maintenance if the system provides pavement sections that have been accepted for maintenance by the Town Board of Commissioners and have been designed and constructed in accordance with the provisions of the Town and this division.

3.1.3 ACKNOWLEDGEMENTS

This section was prepared by Appian Consulting Engineers, P.A. of Rocky Mount, North Carolina, in cooperation with the Town of Wake Forest, North Carolina. However, the content of this division is largely derived from the AASHTO Guide for Design of Pavement Structures [AASHTO, 1986] and the Asphalt Pavement Design System [Taylor, 1993]. These manuals were particularly important because of their format, quality, completeness, and because they represented accepted criteria applied in the area of the Town of Wake Forest.

3.2 STREET DESIGN

All streets within the jurisdiction of the Town of Wake Forest shall meet all the requirements of this manual and the Town Unified Development Ordinance. Designers are to refer to Section 6 of the Unified Development Ordinance for requirements related to pavement width, curb and gutter, etc.

3.2.1 PAVEMENT DESIGN

A. All pavement thickness shall generally be confirmed by a geotechnical report. However, if a developer wishes, he may design cul-de-sac and local streets using a subgrade CBR one standard deviation to the left of the average of all CBR's determined by geotechnical reports thus far. If, in the opinion of the Town's representative, soils appear weaker or have inherent problems such as a high mica content, the services of a geotechnical engineer shall be required in any case for the design of pavements.

B. Pavement must be designed in accordance with the procedures in Section 3.3, Pavement Design Methods.

3.2.2 VERTICAL ALIGNMENT

A. Grades

1. Unless necessitated by exceptional topography and subject to the approval of the Town's Engineer, street grades shall not exceed eight (8%) percent unless approved by the Town's Engineer. Streets to be maintained by the North Carolina Department of Transportation shall not exceed seven (7%) percent. In all cases, street grades shall not be less than one (1%) percent.
2. Grades approaching intersections shall not exceed five (5%) percent for a distance of at least one hundred (100) feet from the centerline of the intersection.
3. Street grades shall be established wherever practicable in such a manner as to avoid excessive grading, the promiscuous removal of ground cover and tree growth, and general leveling of the topography.
4. **Commercial and Industrial driveways or entrance roads tying to a public roadway facility accessible to emergency fire apparatus**: Approach grades shall not exceed 8% or as otherwise allowed or permitted by the Fire Marshall. See NC Fire Code Sections D102 and D103 of Appendix D, Fire Apparatus Access Road. K values shall be as directed by either the Town's Engineer or Fire Marshall but at a minimum shall be sufficient to prevent front or rear bumper drag.

B. Vertical Curves

All changes in street grade shall be connected by a vertical curve having a length of at least 100 feet, or the equivalent in feet, rounded upward to even multiples of 50, of the value of K (given in Table 3.1) times the absolute value of arithmetic difference of the two grades in percent, whichever is greater.

Table 3.1 Minimum K Values

Street Type	K	
	Sag	*Crest*
Major Thoroughfare	140	240
Minor Thoroughfare	100	150
Residential Collector	28	28
Local Street & Cul-de-sac	18	18
Frontage Road	18	18

C. Superelevation: Superelevation shall only be utilized on major thoroughfares except when widening NCDOT streets. Superelevation for shoulder sections shall not exceed 0.08 feet/foot of width. For curb and gutter sections, superelevation shall not be less than 0.02 feet/foot of width or more than 0.06 feet/foot of width.

D. Grading

Grading and filling shall be undertaken to ensure that:

1. The street is centered in the right-of-way.
2. Adequate shoulders and space for future sidewalks are provided.
3. Allowance is made for roadside ditches, curbs and gutters, and storm sewers for street drainage.

4. Cut slopes shall not exceed a ratio of 2:1
5. Fill slopes shall not exceed a ratio of 2:1
6. Ditch front slopes do not exceed a ratio of 4:1 for shoulder sections.
7. See Standard Detail 9.01A.

3.2.3 HORIZONTAL ALIGNMENT

A. Curves

1. Where a street centerline deflection of five (5) or more degrees occurs a curve shall be introduced having a radius of curvature of not less than the following:

Table 3.2 Minimum Horizontal Curve Radii

Type of Street	Minimum Radius
Major Thoroughfare	850
Minor Thoroughfare	500
Residential Collector	300
Local Street	200
Cul-de-Sac	150
Frontage Road	150

2. A tangent of not less than one hundred (100) feet shall be provided between reverse horizontal curves on all streets.

3.2.4 INSTALLATION OF UTILITIES, STORM DRAINAGE, STREET LIGHTS AND STREET TREES

After grading of street right-of-way is completed and approved and before any base is applied, underground work to be installed such as water mains, sewerage mains and taps shall be installed by the developer and approved by the Administrator and Utilities Director.

3.2.5 DRAINAGE

A. Inlet design and spacing to be designed in accordance with Section 2.

B. Streets shall be designed so as not to permit storm runoff to cross intersections. Storm drainage structures should be used to avoid storm runoff crossing intersections. Directional arrows must be shown on plans to reflect surface drainage flow. This is particularly important around curb returns.

C. Under no circumstances will penetration of the back of the curb and gutter be permitted (i.e. "cutdowns" for drainage or small pipes) for drainage.

D. On strip paved streets, the absolute minimum shall consist of shoulders graded to allow water to run off the street and collect in such a manner that it will not return in the subsurface to the base of the street. When soil conditions permit and the property owner desires, roadside drainage may consist of water ponding off the strip paved street until it is absorbed in the ground if, in the opinion of the Town's Engineer, said ponding will not adversely affect the life of the street.

3.2.6 STREET SECTIONS

A. Shoulder Sections/Roadside Ditches

1. Width for shoulder/swale section where appropriate is shown on Detail 9.01A. No on-street parking would be permissible for this cross section. This design would only be appropriate for low-density development.

2. The absolute minimum drainage required on strip-paved streets shall consist of shoulders graded to allow water to run off the street and collect in such a manner that it will not return in the subsurface to the base of the street. When soil conditions permit and the property owner desires, roadside drainage may consist of water ponding off the strip paved street until it is absorbed in the ground, if, in the opinion of the Town's Engineer, said ponding will not adversely affect the life of the street.

3. In all subdivisions where there is no curb and gutter, side ditches, which require protection for erosion caused by excessive velocity shall be concrete paved. Riprap may be accepted upon approval of Town of Wake Forest Engineering staff.

B. Curb and Gutter

1. All curb and gutter shall be constructed according to Standard Detail 9.02 of the Town of Wake Forest Manual of Specifications.

2. The standard 30" curb and gutter section is the preferred type to be used. The 30" concrete valley gutter type may also be used on local and cul-de-sac streets only. Shapes of other curb may be used provided a 6" height is maintained and subject to the approval of the Town's Engineer after review on an individual basis.

3. If the street is to be maintained by the Town of Wake Forest, the Public Works Director shall be consulted for approval of the gutter type. Approval will be subject to the terrain factors in the area under study as they relate to potential maintenance problems.

4. Curb Cuts and Curb ramps: See also, 3.2.7.A, below for curb cuts and curb ramp requirements.

3.2.7 SIDEWALKS

Sidewalk material, width and locations shall be in accordance to the Section 6 of the Town's Unified Development Ordinance.

A. Curb Cuts and Curb Ramps: Curb cuts and curb ramps, commonly used to provide accessibility for persons with disabilities, shall be provided at all intersections where curb and gutter is provided and where sidewalks and/or greenway trails intersect streets subject to the following conditions:

1. Where sidewalk is not required, the curb return shall be depressed to the specified dimensions for the future connection of curb ramps.

2. Sidewalk construction shall meet the applicable provisions of the latest editions of ANSI A117.1, the NC State Building Code, and the 2010 Standards for State and Local Government Facilities: Title II.

3. See Standard Details 9.13 and 9.15 for other requirements pertaining to curb ramp construction.

B. Construction Methods for Brick Sidewalks

1. **Subgrade Preparation**: The subgrade for sidewalks shall be shaped to the proper cross-section and thoroughly compacted by rolling or tamping. Tree roots shall be removed to a depth of 12-inches below subgrade for the full width of the walk. All soft and spongy material shall be removed and replaced with suitable material that shall be compacted in layers not exceeding 6-inches in thickness.

2. **Base**: A 5-inch thick base of stone screenings or sand, well compacted and properly graded to provide drainage according to the standard sidewalk slope, shall be installed. Where the sidewalk is crossed by a driveway, the base shall be increased to 6-inches.

3. **Sidewalk Width & Material**: Except when repairing a non-conforming brick sidewalk, a 5-foot wide sidewalk of paving brick (conforming to ASTM C902) shall be laid to grade with a smooth uniform surface with a slope of ¼-inch per foot toward the street.

4. **Filling Voids**: The voids between the brick shall be filled with a mixture of sand and cement broomed into the voids. The sand-cement ratio shall be 1/3 cement and 2/3 sand well mixed before brooming into the voids. After the voids are well filled, the brick surface shall be cleaned of all excess sand and cement.

3.2.8 MATERIALS TESTING

A. **Asphalt, Concrete and Subgrade Testing:** Refer to Section 3.4, Subgrade Preparation & Testing.

3.3 PAVEMENT DESIGN METHODS

The purpose of this section is to provide a guide for the design of pavement structures for the Town of Wake Forest.

3.3.1 TERMINOLOGY

To fully understand the methods of pavement design that will be outlined in the following sections it is necessary to establish standard terminology. It is noted that many considerations are required to assure that a pavement structure is reliable. For example, material requirements, construction requirements, and quality control will significantly influence the ability of the pavement structure to perform according to design expectations.

A. **Standard Definitions**

1. **Average Daily Traffic (*ADT*):** The average daily traffic using the pavement section at full development.

2. **California Bearing Ratio (*CBR*):** The CBR is the penetration resistance of a soil relative to standard crushed rock.

3. **Design Average Daily Traffic ($\overline{ADT}$):** The average daily traffic over the design life of the pavement.

4. **Pavement Design Life:** All pavement structures for the Town of Wake Forest shall be designed with a 25-year design life.

5. **Soil Support Value (*SSV*):** This value reflects the structural strength of a particular type of soil.

6. **Structural Number (*SN*):** The structural number is an abstract number that reflects the structural strength of the pavement required for soil support and traffic loads.

7. **Traffic Growth Factor (*G*):** This number, typically between 0.00 and 0.07, allows the designer to assume an annual percentage growth rate in the traffic volume and is used to determine the design average daily traffic.

8. **Trip Factor:** The number of vehicles that can be assumed for a particular type of land use. This information is derived from a table of traffic generators of

which some of the factors can be modified by the engineer to best model the exact circumstance of the design.

9. **Truck Factor ($\overline{N}$):** This quantity adjusts the design average daily traffic ($\overline{ADT}$) to account for the percentage of single frame and multiple frame trucks expected along a particular pavement section.

3.3.2 STANDARD SUBDIVISION PAVEMENT DESIGN

Shown below are minimum thicknesses of base and surface course to be used for typical residential subdivision design. Pavement design for any other developments, or design for residential subdivisions which differs from the table below, will be reviewed by the

Town's Engineer on an individual basis according to the Detailed Pavement Design Procedure in Section 3.3.3.

A. Standard Subdivision Pavement Design Table: A design shall be chosen from Group 1 or Group 2 in Table 3.3 below depending on sub-grade soil type.

Table 3.3 Minimum Pavement Sections

GROUP 1 – GOOD TO EXCELLENT		
Sub-Grade Soil Types	**Base Course***	**Pavement Surface**
A-1-a, A-1-b, A-3	7" STBC, Type A or C or 6" CABC	2" S9.5B
A-2-4, A-2-5, A-3-6	9" STBC, Type A or C or 8" ABC	2" S9.5B
A-2-7	8" CABC or STBC, Type B	BST, 2" S9.5B
	6" CABC or STBC, Type B	2" S9.5B
	3" BCBC, Type B25.0B	2" S9.5B
	3-1/2" BCBC, Type B25.0B	2" S9.5B
		5" Plain Concrete
GROUP 2 – POOR TO FAIR		
Sub-Grade Soil Types	**Base Course***	**Pavement Surface**
A-4, A-5, A-6, A-7-5,	9" STBC, Type A or C or 8" CABC	2" S9.5B
A-7-6	8" CABC or STBC, Type B	2" S9.5B
	10" CABC or STBC, Type B	BST, 1 1/2" S9.5B
	4" BCBC, Type B25.0B	2" S9.5B
	3" BCBC, Type B25.0B	2" S9.5B or 6" Plain Concrete

** No base course shall be placed on muck, pine clay, vegetable matter or other unsuitable material.*

CABC: Aggregate Base Course
STBC: Soil Type Base Course
BST: Bituminous Surface Treatment
SF9.5A: Sand Asphalt, Type SF9.5A
S9.5B: Bituminous Concrete Surface Course, Type S9.5B
BCBC: Bituminous Concrete Base Course, Type B25.0B

B. Other base courses such as various cement-treated materials may be used in lieu of those shown above. These materials shall be of sufficient thickness to provide equivalent strength. However, any design other than those shown above must be approved prior to use. The total thickness of the pavement structure shall in no case be less than 5".

3.3.3 DETAILED PAVEMENT DESIGN PROCEDURE

A. Pavement Design Life

All pavement structures for the Town of Wake Forest shall be designed with a pavement design life of 25 years.

B. Determine the Design Average Daily Traffic ($\overline{ADT}$)

1. From Table 3.4, locate the best description of the land use for which the proposed pavement section will serve and determine the total number of trips per day per unit. Multiply the trips per day per unit by the total number of units using the street at full development. This total number of trips per day is the average daily traffic (*ADT*) at full development.

Table 3.4 Trips per Day According to Land Use (for pavement design only)

Description of Land Use	Trips/ Day/ Unit	Unit
Residential		
• Apartments	6.29	DU
• Condominiums	5.69	DU
• Mobile Homes	4.77	DU
• PUD	6.96	DU
• Retirement Home	3.3	DU
• Single Family Homes	9.53	DU
Lodging		
• Hotel	8.93	Room
• Motel	5.63	Room
• Nursing Home	2.0	Bed
Retail		
• New Car Sales	38.72	1,000 gsf
• Convenience Store (24 hr)	758.79	1,000 gsf
• Restaurant (Quality)	92.55	1,000 gsf
• Restaurant (High-Turnover)	158.37	1,000 gsf
• Restaurant (w/Drive Thru)	623.19	1,000 gsf
• Restaurant (w/o Drive Thru)	778.18	1,000 gsf
• Building & Lumber Store	28.80	1,000 gsf
• Special Retail Center	37.97	1,000 gsf
• Discount Store	70.56	1,000 gsf
• Hardware/Paint Store	58.23	1,000gsf
• Garden Center	44.51	1,000 gsf
• Furniture Store	4.67	1,000 gsf
• Shopping Center (0 to 50,000 sf)	115.8	1,000 gsf

• Shopping Center (50,000 to 100,000 sf)	79.1	1,000 gsf
• Shopping Center (100,000 to 200,000 sf)	60.4	1,000 gsf
• Shopping Center (200,000 to 300,000 sf)	49.9	1,000 gsf
• Shopping Center (300,000 to 400,000 sf)	40.4	1,000 gsf
• Shopping Center (400,000 to 500,000 sf)	47.6	1,000 gsf
• Shopping Center (500,000 to 1,000,000 sf)	34.5	1,000 gsf
• Shopping Center (Greater than 1,000,000 sf)	26.5	1,000 gsf
• Supermarket	172.02	1,000 gsf
Industrial		
• Light Industrial	5.26	1,000 gsf
• Industrial Park	5.44	1,000 gsf
• Manufacturing	3.05	1,000 gsf
• Mini Warehouse	2.45	1,000 gsf
• Warehousing	3.77	1,000 gsf
Port and Terminal		
• Aviation Airport	1.98	Av. Flts/day
• Truck Terminal	62.48	Acre
Recreational		
• Golf course	8.18	Acre
• Athletic/ Fitness/ Gym	10	1,000 gsf
• Racquet Club	17.14	1,000 gsf
Institutional		
• Elementary School	10.72	1,000 gsf
• High School	10.90	1,000 gsf
• Community College	1.6	Student
• University	2.4	Student
• Library	39.75	1,000 gsf
• Church	13.28	1000 gsf
• Day Care Center	58.33	1,000 gsf
Office		
• General Office	15.00	1,000 gsf
• Corp. Headquarters Bldg.	6.27	1,000 gsf
• Medical Office Building	25.91	1,000 gsf
• Office Park	8.50	1,000 gsf
• Research Center	5.93	1,000 gsf
• Business Park	10.89	1,000 gsf
Medical		
• Hospital	15.25	1,000 gsf

Services		
• Bank (Walk-In)	190.44	1,000 gsf
• Bank (Drive-In)	201.56	1,000 gsf

GSF = Gross Square Feet; D.U. = Dwelling Unit
Note: Trip Rate based on a daily average calculated over one week.
Source: Institute of Transportation Engineers. *Trip Generation*, (latest edition should apply)

2. The next step in determining the design average daily traffic is to determine the traffic growth factor (*G*). This number, typically between 0.00 and 0.07, allows the designer to assume an annual percentage growth rate in the traffic volume. If significant future development is expected to occur along the proposed corridor, then future potential traffic should be accounted for and can be accommodated for by using a percentage increase in traffic volume. If there is no significant future development expected due to saturation or because there are no other possible inlets or outlets, the percent of growth should be close to zero (0). The traffic growth factor shall be obtained from Equation 3.1.

$$G = (1+i)^n \qquad \textbf{(Equation 3.1)}$$

Where,

G = Traffic growth factor

i = fractional rate of yearly increase, from Table 3.5

n = Design Life of Pavement, years

Table 3.5 Traffic Growth Rate

Facility Description	Estimated Yearly Increase
Dead End Street	0.01
Connector Street	0.02
Subdivision Street	
Fully Developed	0.005
50% Developed	0.04
Industrial Service Road	
Undeveloped	0.06
50% Developed	0.04

Source: "Manual of Specifications," City of Rocky Mount, NC, 1991.

3. The Design Average Daily Traffic ($\overline{ADT}$) shall then be calculated according to the following formula:

$$\overline{ADT} = \frac{ADT + (G \times ADT)}{2} \qquad \textbf{(Equation 3.2)}$$

Where,

$\overline{ADT}$ = Average Daily Traffic (trips/ day)

G = Traffic growth factor, as described above

C. Determine the Truck Factor: The truck factor adjusts the design average daily traffic ($\overline{ADT}$) to account for the percentage of single frame and multiple frame trucks expected along a particular pavement section. Single frame trucks refer to those trucks with dual wheels on the rear axle, such as delivery trucks. Multiple frame trucks refer to tractor-trailers, semi-trailers, and garbage trucks (which have very high loadings per tire compared to most vehicles). If the designer does not have information to estimate these percentages, 4% single frame trucks ($x = 0.04$) and 1% multiple frame trucks ($y = 0.01$) may be used. Table 3.6 lists equivalent truck factors for various design average daily traffic quantities at these percentages.

$$\overline{N} = \overline{ADT}\,(0.25x + 0.60y) \qquad \textbf{(Equation 3.3)}$$

Where,

$\overline{N}$ = Truck Factor

x = Percentage Single frame trucks

y = Percentage Multiple frame trucks

Table 3.6 Equivalent $\overline{N}$ and $\overline{ADT}$ *

$\overline{ADT}$	$\overline{N}$
12,500	200
6,250	100
5,000	80
2,500	40
1,875	30
1,562	25
1,250	20
937	15
625	10
312	5
250	4
187	3
125	2
63	1

*Tabulated values assume 4% single frame and 1% multiple frame traffic.
Source: "Manual of Specifications," City of Rocky Mount, NC, 1991.

D. Determine the Soil Support Value (*SSV*)

1. All pavement thicknesses shall generally be confirmed by a geotechnical report. However, if a developer wishes, he may design cul-de-sac and local streets using a subgrade CBR one standard deviation to the left of the average of all the CBR's determined by geotechnical reports thus far. If, in the opinion of the Town's representative, soils appear weaker or have inherent problems such as high mica content, the services of a geotechnical engineer shall be required in any case for the design of pavements.

2. The designer may choose one of three methods to determine the soil support value (*SSV*).

   a. Measure the CBR of Soils and Calculate the *SSV*

   b. Measure the CBR of Soils to be Used as Fill and Calculate the *SSV*

   c. Assign a *SSV* from the Soil Classification of the County Soil Map

3. Measure the CBR of Soils and Calculate the *SSV*

a. This is the most accurate method to determine the actual characteristic of the subgrade base material because it is based on an actual laboratory CBR (California Bearing Ratio) test that has been approved by a soil laboratory. The CBR test should be performed in accordance with AASHTO designation T193 (latest edition) with the exception that if the required soil compaction density to be used during construction is known, only one specimen needs to be tested at the required density for each soil type.

b. Certification and report of tests performed by an approved soils laboratory shall be submitted to the Town of Wake Forest Engineering Department.

c. Although the following minimum testing is required, a sufficient number of CBR tests shall be made to determine the consistency of the soil conditions in the area to be paved.

i. Soil Borings – Perform soil borings with a maximum spacing of 250 linear feet and with at least four (4) borings in each separate street area and with at least one (1) boring in each soil type area identified in the soil survey map of Wake County, if available. Each boring shall extend at least two (2) feet below the finished subgrade elevation. The Engineer may require more depth as the conditions warrant.

ii. CBR Tests – A CBR test shall be performed on each soil type that will be within two (2) feet of the finished subgrade elevation. If off-site soils are used as fill, CBR tests shall also be performed on each soil type that will occur in the upper two (2) feet below pavement subgrade.

d. The CBR value shall then be substituted in Equation 3.4 to obtain the soil support value (*SSV*).

$$SSV = 5.32\,(\log CBR) - 1.52 \qquad \textbf{(Equation 3.4)}$$

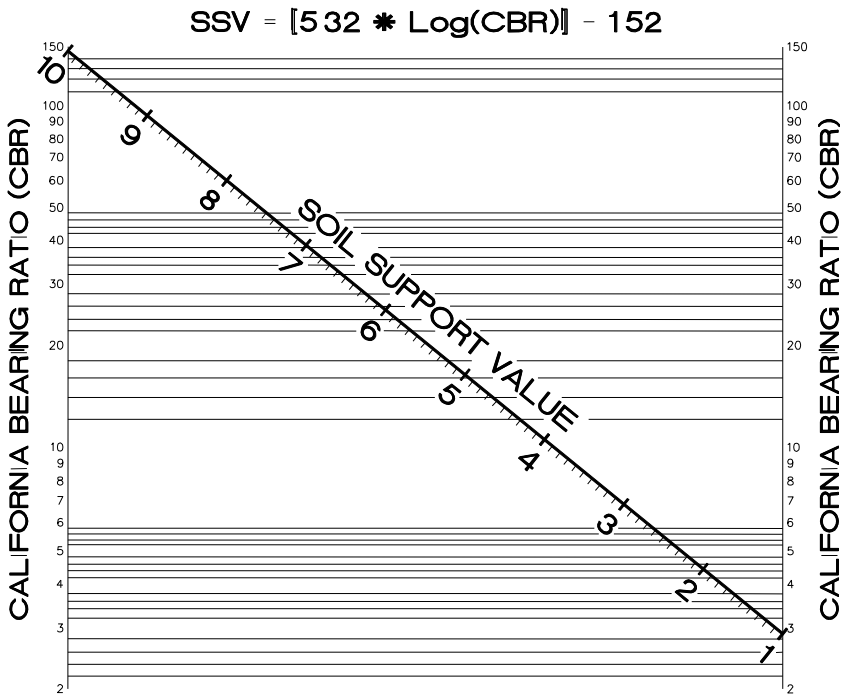
Where,

SSV = Soil Support Value

CBR = California Bearing Ratio (as determined by laboratory report or Figure 3.1)

e. Figure 3.1 can also be use to quickly determine the CBR for the soil in study.

Figure 3.1 Soil Support Values (SSV) per CBR



Source: "Manual of Specifications," [City of Rocky Mount, 1991].

4. **Measure the CBR of Soils to be used as Fill and Calculate the *SSV***

   a. If the characteristics of the existing soils in the area to be paved result in an uneconomical pavement section based on the two preceding methods, the developer may opt to undercut the existing soils to a depth of at least 18 inches below the finished pavement subgrade elevations and backfill with better material. The *SSV* for the proposed pavement section is then determined by performing a CBR test on each soil type used for backfilling (performed in accordance with AASHTO designation T193, latest edition).

   b. The CBR value determined by laboratory testing shall then be substituted in Equation 3.4 to obtain the soil support value (*SSV*).

5. **Assign a *SSV* from Soil Classification of the County Soil Map**

   a. The soil types may be determined by using, if available, the "Soil Survey of Wake County, North Carolina" prepared by the United States Department of Agriculture, Soil Conservation Service. This method is usually more conservative than designs based on actual laboratory data as described in Section 3.3.3.D.3 and will generally require a thicker pavement section.

   b. Locate the project on the soil maps and determine the soil types in the areas to be paved. A copy of the soil survey map with the boundaries of the property and areas to be paved shall be submitted to the Town of Wake Forest Engineering Department.

   c. From the Engineering Index Properties Table determine the AASHTO Classification of the soil types. From this information, use Table 3.7 and/or

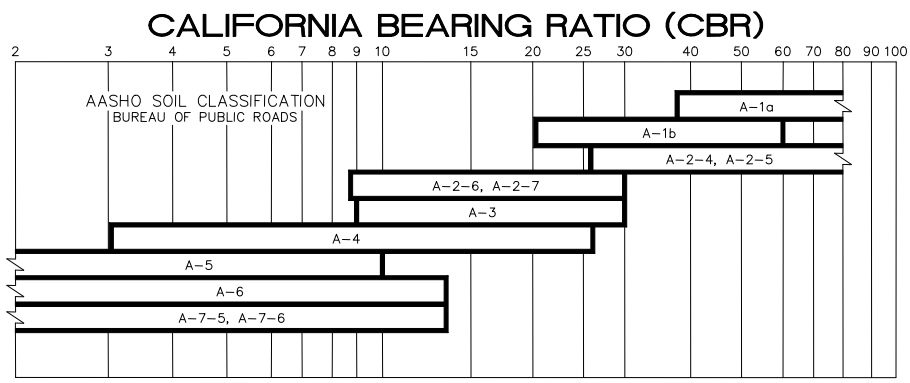
Figure 3.2 to assign the most appropriate soil support value (*SSV*). The entire paved area shall be designed using the lowest *SSV* obtained along any portion of the paved area. The CBR value determined from Figure 3.2 shall then be substituted in Equation 3.4 to obtain the soil support value (*SSV*).

Table 3.7 Assigned Soil Support Values (SSV)

AASHTO Soil Classification	Assigned *SSV*
A-1-a	4.2*
A-1-b	4.2*
A-3	3.5
A-2-4	4.2*
A-2-5	4.2*
A-2-6	3.4
A-2-7	3.4
A-4	1.0
A-5	1.0
A-6	1.0
A-7-5	1.0
A-7-6	1.0

*Suggested Maximum *SSV* by NCDOT without CBR Test, although AASHTO Soil Classification indicates higher value.
Source: "Manual of Specifications," City of Rocky Mount, NC, 1991

Figure 3.2 CBR Values per Soil Classification



Source: AASHTO Bureau of Public Roads.

E. Determine the Structural Number (*SN*)

1. The structural number is an abstract number that reflects the structural strength of the pavement required for soil support and traffic loads. Obtain the structural number (*SN*) for the given soil support value (*SSV*) and truck factor ($\overline{N}$) from Figure 3.3 and/or Equation 3.5.

$$SN = \frac{2.41\ (\overline{N})^{0.151}}{(1.14)^{SSV}} \qquad \textbf{(Equation 3.5)}$$

Where,

SN = Structural Number required for the design pavement section

$\overline{N}$ = Truck Factor, see Section 3.3.3.C

SSV = Soil Support Value, see Section 3.3.3.D

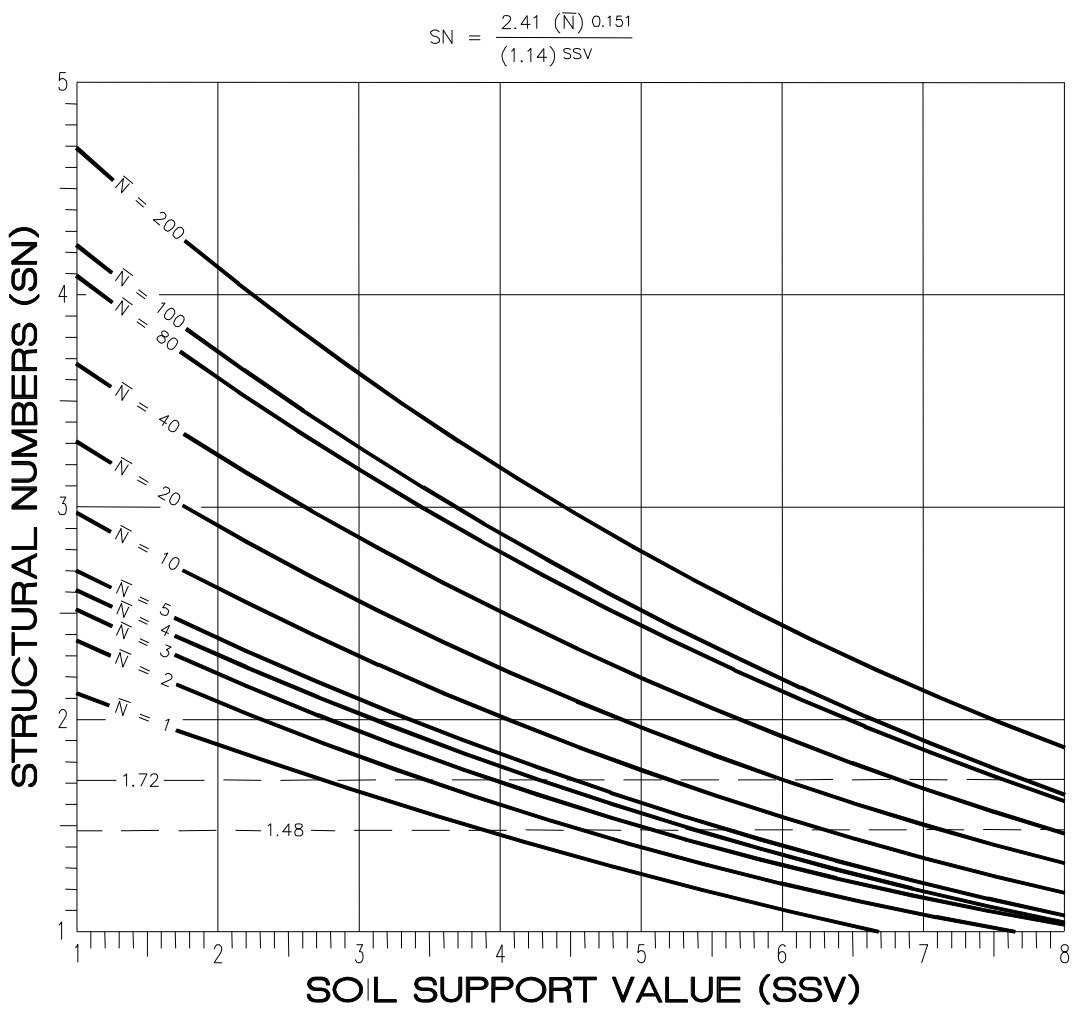
2. The designer should not use a *SN* below 1.72 for poor to fair subgrade soils nor below 1.48 for good to excellent subgrade soils

a. For collector streets, add 1.0 to the structural number.

b. For minor thoroughfares, add 1.5 to the structural number.

c. For major thoroughfares, add 2.0 to the structural number.

Figure 3.3 Structural Numbers for Pavement Sections



Source: "Manual of Specifications," [City of Rocky Mount, 1991].

F. Determine the Structural Coefficients: From Table 3.8, determine the structural coefficient for each layer in the design pavement section.

Table 3.8 Structural Coefficients for Pavement Design

Permanent Layer	Type of Material	Structural Coefficient per inch of Thickness
Surface Courses	Bituminous Concrete Type SF 9.5A; S 9.5X	0.44
	Bituminous Surface Treatment	0.20[a]
Binder Course	Bituminous Concrete Type I 19.0X	0.44
Base Courses	Coarse Aggregate Base Course (CABC)	0.14
	Bituminous Concrete Type B 25.0X	0.30
	Cement Treated ABC (CTABC)	0.23
Subgrade	Cement Stabilized Subgrade (Soil-Cement)	0.14[b]
	Lime Stabilized Subgrade (Soil-Lime)	0.13[b]

[a]Bituminous surface treatment. Do not multiply by thickness in calculations.
[b]For design purposes, do not exceed 1.0 for total depth of subgrade stabilized.

Source: "Paragraph 3.7, *Layer Coefficients*, NCDOT *2006 QMS Manual*", *NCDOT April 2000 Interim Pavement Design Procedure*," updated November 2007.

1. Commentary on Subgrade Stabilization and Pavement Section Performance:

   a. **Lime Stabilized Subgrade:** Pozzolanic materials are siliceous substances that will react with lime in the presence of water. Clays are pozzolanic and react with lime to form cement. Lime (approximately 5%) is worked 7 to 8 inches into the subgrade in order to reduce the plasticity of the subgrade soil. However, lime cannot be used with sand.

   b. **Cement Stabilized Subgrade**: Cement is used with sand to form a Cement Stabilized Subgrade (soil cement). Thickness is generally 7 inches.

   c. **Best Performing Pavement Section:** By monitoring pavement sections under highway traffic, research has found that the best performing pavement section is comprised of asphalt, aggregate base (ABC) and a lime treated subbase (especially areas where clay-type soils are prevalent). This section performed better than full-depth asphalt pavement sections. [7] Subgrade strength is very important to the performance of asphalt pavements (as opposed to concrete pavements).

G. Select Pavement Thickness to Obtain Required Structural Number

1. Design the pavement section such that the structural number (*SN*) designed is equal to or greater than the number obtained in Section 3.3.3.E. This design may be done by trial and error. However, the minimum pavement section in the Town of Wake Forest shall be no less than that shown in Table 3.3.

2. Multiply an initial thickness (in inches) of the various components of the pavement section (base course, binder course, and surface course) by the corresponding structural coefficient and sum the results. The total number must be equal to or greater than the structural number obtained in Section 3.3.3.E.

3. The combination of layers and structural coefficients that sum greater than the required structural number is the *minimum* pavement design allowable for the particular area to be paved.

H. Minimum Asphalt And Aggregate Thickness

1. Minimum Asphalt Concrete Pavement Thickness: The minimum total asphalt concrete thickness shall not be less than 1 1/2 inches (minimum single lift thickness for S9.5B) for any public roadway.
2. Minimum Aggregate Base Course Thickness: The minimum aggregate base course thickness shall not be less than 6 inches for any public roadway.

I. Summary Sheet

The designer shall provide a summary sheet, either attached to or included in the Geotechnical report, similar in layout to the following example summary sheet. Pavement calculations shall be attached to the summary sheet.

Figure 3.4 Summary Sheet

PAVEMENT DESIGN SUMMARY SHEET						
Street Name	**Avg CBR**	**Facility Classification (Local, Collector, etc.)**	**ADT Range**	**SN**	**Design Pavement Cross-section**	**Special needs (subdrain, fabric, etc.)**

The designer may group similar facilities by corresponding average CBR'/ADT's. However, realizing the variability in soil type and traffic (ADT and truck composition), the designer may need to provide a separate line for each street or section of street (identified by block).

3.3.4 EXAMPLE OF PAVEMENT DESIGN

Figure 3.5 Example of Pavement Design

Design a pavement section for a street accessed by a development consisting of 100 lots in a high density single family residential subdivision. No CBR test is available, however, soils are found to be type A-3 from the county Soil Survey. Assume normal truck loading. Follow the design procedures in this design manual.

Solution:

1. Determine the Design Average Daily Traffic ($\overline{ADT}$):
   - Using Table 3.4 for single family homes,

$$ADT = 9.53 \ trips \ / \ day \ / \ dwelling \times 100 \ dwellings = 953 \ trips \ / \ day$$

   - Using Table 3.5 for a subdivision street (fully developed) the estimated yearly increase is 0.5%., so *i* = 0.005, in Equation 3.1.
   - The Town requires that all pavement sections be designed for a 25 year design life, so *n* =25, in Equation 3.1. It follows that:

$$G = (1+i)^n = (1+0.005)^{25} = 1.13$$

   - Using Equation 3.2:

$$\overline{ADT} = \frac{ADT + (G \times ADT)}{2} = \frac{953 + (1.13 \times 953)}{2} = 1015 \ trips \ / \ day$$

2. Using Equation 3.3, determine the Truck Factor, assuming 4% single frame trucks and 1% multiple frame trucks:

$$\overline{N} = \overline{ADT} \ (0.25x + 0.60y) = 1015[(0.25)(.04) + (0.60)(0.01)] = 16.2 \pm$$

3. Determine the *SSV*. Although a CBR is not available, the county soil survey classifies the soils in the area as type A-3. From Table 3.7, for A-3 soils, it is found that:

$$SSV = 3.5$$

4. Determine the Structural Number (*SN*). Substituting the known values into Equation 3.5,

$$SN = \frac{2.41 \ (\overline{N})^{0.151}}{(1.14)^{SSV}} = \frac{2.41 \ (16.2)^{0.151}}{(1.14)^{3.5}} = 2.32$$

See paragraph 3.3.3.E.2 for minimum permitted Structural Number.

5. Determine Structural Coefficients. Choose an S9.5B asphalt layer over a CABC layer over the subgrade for the pavement section. From Table 3.8, S9.5B coefficient is 0.44 and CABC coefficient is 0.14.

Note: The minimum pavement section allowed for a local street w/ A-3 subgrade, per Table 3.3, is 2 inches of S9.5B over 6 inches of CABC: *SN* = 1.72.

6. Select pavement thickness to obtain required structural number. Try different sections.
   - Try 6" CABC — 6 x 0.14 = 0.84
     2" S9.5B — 2 x 0.44 = 0.88
     1.72 < 2.32, Design *INSUFFICIENT*
   - Try 6" CABC — 6 x 0.14 = 0.84
     3" S9.5B — 3. x 0.44 = 1.32
     2.16 < 2.32, Design *INSUFFICIENT*
   - Try 8" CABC — 8 x 0.14 = 1.12
     3" S9.5B — 3 x 0.44 = 1.32
     2.44 > 2.32, Design *SUFFICIENT*

See paragraph 3.3.3.H for minimum allowable layer thickness thicknesses.

The designer may choose the sufficient pavement section that is preferred. For the given situation, ***choose 3" S9.5B asphalt over 8" CABC over compacted subgrade as the design pavement section.***

3.4 SUBGRADE PREPARATION & TESTING

The purpose of this section is to provide a guide for the subgrade preparation of paved areas within the Town of Wake Forest.

3.4.1 SUBGRADE INSPECTION – CBR TESTING

A. If the soils at the site were tested to obtain the CBR and SSV as described in Section 3.3.3.D.3 and Section 3.3.3.D.4, the soils below the proposed pavement subgrade must be compacted during construction to a density equal to or greater than the density at which the CBR test was performed. Unless filling is involved, the upper twelve (12) inches of soil below the proposed pavement section must be compacted.

B. After the subgrade has been brought to grade, the design assumptions shall be confirmed by visual inspection and classification of the subgrade soils by the Geotechnical Engineer that performed the original investigation. In-situ CBR's do not have to be taken to verify the design pavement section unless the exposed subgrade is deemed by the Geotechnical Engineer to be at variance with original CBR's.

3.4.2 SUBGRADE INSPECTION – DENSITY TESTS

A. In the areas where the roadway has been filled (fill sections), the soil below the pavement section must have been placed in lifts, compacted, and verified by field density tests during fill placement to meet the minimum requirements outlined in Specification Section 02200, Earthwork. The test results shall be submitted to and approved by the Town's Engineer prior to placement of stone base.

B. Field density tests do not have to be performed in either cut sections or undercut areas. Proofrolling shall be performed on these areas. However, if the undercut area is considered to be extensive, as determined by the Town's Engineer, the Town's Engineer may require that density tests be performed in those areas during placement of borrow/fill.

C. The subgrade in cut sections must be compacted prior to proofrolling.

3.4.3 SUBGRADE INSPECTION – PROOFROLLING

A. No pavement shall be placed in the Town of Wake Forest without prior inspection and approval by the Town of Wake Forest Engineering Department. The inspection shall include, but not be limited to, proofrolling the prepared subgrade with a rubber-tired proof-roller (**fully loaded** dump truck) that has a minimum gross weight of at least 20,000 pounds (10 tons) under the observation of a representative of the Town. **No other method will be acceptable.** The developer shall bear the costs of proofrolling, which must be done within ten (10) days prior to placement of the asphalt. All areas of the subgrade shall be covered by the wheels of the proof-roller operating at walking speed (two or three miles per hour).

B. The earthen subgrade must pass a proof-roll prior to the placement of the stone base course or the concrete curb and gutter. The stone base course must in turn pass proofrolling prior to placement of asphalt on the stone base. A proofroll must be repeated on any previously inspected subgrade following a rain event. At a minimum, visual inspection of stone base course following a precipitation event is required.

C. Any areas that rut, or pump excessively under the wheels of the proof-roller, as determined by the Town's Engineer, shall be repaired by the developer before the street is paved. Those repaired areas, at the discretion of the Town's Engineer, may be required to be proofrolled prior to placement of stone or asphalt, as applicable.

Prior to placement of either stone base or asphalt, while exposed to weather, the Contractor shall exercise care and diligence in protecting and maintaining drainage of the subgrade in order to minimize the potential for subgrade deterioration.

D. Should the Contractor or Developer disagree with the representative of the Town about the need for repairs to the subgrade, the Contractor, developer or his project engineer may employ a Licensed Professional Geotechnical Engineer to perform such tests as may be required to confirm the adequacy of the prepared subgrade with the test results provided to the Town's Engineer for review and approval. If the Geotechnical Engineer certifies that the full width and length of the subgrade will provide adequate support for the design pavement section as prepared by the Contractor and the anticipated loading for the design life of the paved area, the area may be paved without making repairs to the subgrade. However the Town's Engineer reserves the right to request/require such additional tests as deemed necessary to satisfy himself/herself as to the adequacy of the subgrade.

E. All construction and testing of materials shall be in accordance with the Town of Wake Forest Manual of Specifications.

3.5 STREET INSPECTIONS & TESTING

3.5.1 MINIMUM INSPECTON CRITERIA

A. Minimum Inspections: The following shall be the minimum inspections required by the Town:

1. **Proofroll Curb & Gutter:** No base course under curb and gutter except as required by the geotechnical report.

   Concrete samples must be taken for slump and strength.

   The initial test (from first ready mix truck) is to be taken after the second yard is dispatched from the mixer and is to consist of the following:

   a. One slump test

   b. Pull, prepare and store 3 cylinders on-site for 24 hours.

   c. Temperature

   Subsequent tests: after the above tests are pulled from the initial truck, every 5th truck thereafter is to be tested in the same manner as noted above.

2. **Proof roll street subgrade:** If stone is used to help stabilize subgrade, the poof roll must be at subgrade elevation. See Section 3.4.2 and 3.4.3 above for proof rolling procedure.

3. **Crossfall on subgrade** from crown to curb shall be checked with a string line prior to placement of base course.

4. **Base course** shall be proof rolled just prior to placement of asphalt. Crossfall on base course, from crown to curb, shall be checked with a string line prior to placement of asphalt. Quarter points in particular shall be checked. Cracked curb is to be removed prior to paving.

5. **Paving lifts**: If the proposed asphalt layer depth exceeds the maximum single lift thickness shown in Table 3.9 below, asphalt must be placed in **two lifts;** the first lift having a thickness of not less than the minimum single lift depth shown in Table 3.9 below. Maximum layer depth, shown in Table 3.9 shall not be exceeded. Asphalt cores must be taken to confirm thickness and compaction. See Section 3.5.2, Testing, below.

Table 3.9 Recommended Pavement Thickness Chart

Mix Type	*Minimum Single Lift Depth (inches)*	*Maximum Single Lift (inches)*	*Maximum Layer Depth (inches)*
SF 9.5A	1	2	3
S 9.5X[a]	1.5	2	3
S 12.5X[a]	2	2	4
I 19.0X[a]	2.5	4	4
B 25.0X[a]	3[b]	5.5	No Restrictions
B 37.5C[a]	4.5	6	No Restrictions
ABC[c]	4	10[d]	No Restrictions

Source: NCDOT 2006 HMA/QMS Manual.

[a] X= Level of Service.
[b] For **B 25.0X** placed on stabilized subgrade, minimum lift thickness is 4.0 inches.
[c]Construct the base so that the thickness of the base is within a tolerance of plus or minus ½ inch of the base thickness required by the plans.
[d]Where the required compacted thickness is more than 10 inches, spread the base material in 2 or more approximately equal layers. Compact the base material to a minimum thickness of approximately 4 inches for any one layer.

6. **Temperature** (Ambient Air and Mix): See temperature requirements for asphalt in Section 610-4 and in Table 610-5 of NCDOT *Standard Specifications for Roads & Structures*, latest edition, Placement Temperatures for Asphalt. For concrete, see Section 02400 – Curb & Gutter, Sidewalks, & Driveways, paragraph 3.4.9 B, Cold Weather Concreting.
7. **Sidewalk** forms and subgrade shall be checked prior to pouring. Slump and strength tests shall be required. See Section 3.5.2, Testing, below.
8. All **driveway** forms must be checked prior to pouring. If a ditch and shoulder section is used, culvert inverts must be checked.
9. **Driveway culverts** must be installed to ensure positive and uniform ditch flow line grade between publicly maintained structures/culverts.
10. **Grade and Alignment**: The Town shall not be responsible for ensuring proper grade and alignment.

B. CO Inspections

Before a Certificate of Occupancy will be granted, the following shall be the minimum inspections required by the Town:

1. Broken Curb & Gutter along frontage
2. Broken Sidewalk where applicable
3. Broken driveway aprons
4. Sewer cleanout set per City of Raleigh standards
5. Water meter box set per City of Raleigh standards
6. Grade right-of-way per Standard Detail 9.01A.
7. All temporary Erosion Control Measures have been removed
8. Adequate ground cover has been established per approval by the Town of Wake Forest Engineering Department

C. Geotechnical Engineering Inspection Services:

1. The services of a Geotechnical Engineer shall be required in all cases where unusual soil conditions have been found during construction such as high water table or springs, soft or yielding soils, unsuitable soils, or
2. A developer may elect to use the services of a consulting Geotechnical Engineer to perform all inspections of streets. In this case, the Geotechnical Engineer shall be required to guarantee that the street shall perform as required.
3. See also paragraphs 3.4.2 and 3.4.3, as applicable.

D. Inspection Fee: All inspections, which fail, are subject to a re-inspection fee.

E. Inspection Procedure: Warranty, maintenance during warranty period, inspection procedure, repairs, utility cuts, etc. are covered under Section 3.6, Warranty & Acceptance.

3.5.2 TESTING

A. Concrete Testing:

1. The initial test (from first ready mix truck) is to be taken after the second yard is dispatched from the mixer and is to consist of the following:
   a. One slump test
   b. Pull, prepare and store 3 cylinders on-site for 24 hours. Do not store at locations subject to vibration. Deliver to lab for a 7-day and 28-day break test.
   c. Temperature
2. **Subsequent tests**: after the above tests are pulled from the initial truck, every 5th truck thereafter is to be tested in the same manner as noted above. The Inspector may require two additional tests per truck if he/she feels the condition of the concrete has changed.
3. **Slump Test Limitations**

Table 3.10 Slump Test Limitations

APPLICATION	ALLOWABLE SLUMP	REFERENCE
Hand poured Curb and Gutter	2" to 3 ½"	02400, 3.4.12
Machine formed Curb and Gutter	0-2"	02400, 3.1.2.E
Other Applications	as specified by Town's Engineer	02400, 3.4.12

B. Asphalt Testing

1. **Compaction**: Testing for asphalt density is to follow NCDOT "Standard Specifications for Roads and Structures," Section 609-7, "Field Compaction Quality Control," latest revision.
2. **Thickness**: The minimum frequency of coring for thickness testing shall be on the basis of test sections consisting of not more than 1500 linear feet of lay down width, exclusive of intersections and irregular areas. The test sample is to be a 6-inch diameter cored sample. The sample is to be numbered and logged for identification purposes.
3. **Contractor's Quality Control System**: Follow NCDOT "Standard Specifications for Roads and Structures," Section 609-4 "Contractor's Quality Control System Personnel Requirements" and 609-5. "Contractor's Quality Control System Field Laboratory Requirements," latest revisions.

4. **Mixture and Job Mix Formula Adjustments**: Follow NCDOT "Standard Specifications for Roads and Structures," Section 609-6, "Plant Mix Quality Control," latest revision.

5. **General**: All other applicable sections of Section 609 of the NCDOT "Standard Specifications for Road and Structures" shall apply relating to Quality Control Plan, mix design, control limits, corrective action, equipment and measurement.

6. **Testing Cost**: Project owner is responsible for cost of testing.

3.5.3 SETUP PERIOD

A. Unless otherwise waived by the Town's Engineer, for all new areas to be paved, the developer shall be required to wait at least six (6) months before the final lift of asphalt is placed. This setup period includes the winter months through February.

B. Existing streets that are to be rebuilt or reconstructed will not be required to meet this setup period and may be paved when the specifications in this manual are met and approved.

3.5.4 MAINTENANCE

For warranty, maintenance during warranty period, inspection procedure, repairs, utility cuts, etc. see Section 3.6, Warranty & Acceptance.

3.5.5 WARRANTY

Warranty, maintenance during warranty period, inspection procedure, repairs, utility cuts, etc. are covered under Section 3.6, Warranty & Acceptance.

3.6 WARRANTY & ACCEPTANCE

3.6.1 GENERAL REQUIREMENTS

A. Prior to commencing construction, all approvals including plan approval and all permits and encroachments shall be obtained. Site grading **only** may be performed upon issuance of a grading permit from the Town of Wake Forest. All other construction must await the issuance of all remaining permits. A preconstruction conference must also be held prior to commencing **any** construction.

B. The developer is responsible for the maintenance and repair of streets for twelve (12) months after acceptance by the Town for warranty. At the end of twelve (12) months the Town of Wake Forest will accept permanent responsibility. If a significant failure occurs requiring extensive maintenance during the first year of service, the Town's Engineer shall suspend the twelve-(12) month warranty until the failure is repaired to an acceptable condition.

C. The developer is responsible for the maintenance and repair of all paved areas other than streets.

D. No contractor shall permit mud or construction debris to accumulate in any paved street which is maintained or is proposed to be maintained by the Town of Wake Forest.

E. The final lift of asphalt cannot be laid before 25% of the lots in a subdivision have been developed, but shall be laid before 75% of the lots in a subdivision have been developed.

3.6.2 INSPECTIONS

A. Upon completion of construction, the developer shall request a final inspection. Upon completion of all punch list items, the provision of a set of acceptable record drawings, and the submission of engineer's certifications, a one-year warranty period shall commence.

B. During the one-year warranty period the developer shall promptly repair any latent defects which occur. At the end of the one-year warranty period, the developer shall request a warranty inspection. Upon successful completion of all warranty items the developer shall be released from maintenance responsibilities for the warranted construction.

C. All inspections must be scheduled the day prior to when needed. Inspections will be performed in the order received. Every effort will be made to accommodate the time of request; however, this cannot be guaranteed.

D. All inspections, which fail, are subject to a re-inspection fee.

3.6.3 MAINTENANCE

A. Existing Streets: The Town will assume all maintenance responsibility on all existing paved streets. If an individual owner wishes to pipe an existing roadside ditch and/or install curb and gutter in front of their property, the Town's Engineer shall make a determination whether it is favorable to do so. The Town will at its option install these improvements. If the Town installs these improvements it shall require the owner to pay the full cost of the materials. The Town will cover labor and equipment cost.

B. Existing Strip Paved Streets: The Town shall maintain existing strip-paved streets in the following manner:

1. Streets that have an adequate base and inadequate roadside drainage system shall be resurfaced as required. This maintenance shall be at the sole cost and expense of the Town.

2. Streets that have an inadequate base, but an adequate roadside drainage system shall have the inadequate base replaced and shall be resurfaced as required. If in the judgment of the Town's Engineer, more than one-half of the street surface needs its base replaced, the Town's Engineer may recommend that the street be rebuilt with curb, gutter, and paving to standard Town of Wake Forest specifications. The Board of Commissioners will make the final determination as to whether the street is to be rebuilt with curb and gutter.

3. Streets that have inadequate base and/or inadequate roadside drainage will be resurfaced and drained as required. If, in the judgment of the Town's Engineer, one-half of the street surface needs its base replaced or if adequate roadside drainage cannot be obtained without extensive work, the Town's Engineer may recommend that the street be rebuilt with curb, butter and paving to standard Town specifications.

4. If a new roadside ditch is required and its invert elevation is more than 30" below the elevation of the edge of the finished asphalt surface, the resident may:

a. Elect to have the ditch remain open, or

b. Elect to have the ditch piped with the total cost of the piping and appurtenances being assessed against the property in a manner consistent with other street improvement assessments, or

c. Elect to have curb and gutter and pavement widening installed in accordance with existing assessment policies.

The Board of Commissioners will make the final determination for which option best meets the interest of the Town and parties involved.

5. Streets that intersect streets that have been petitioned for curb and gutter that also need curb and gutter to adequately drain into the street to be improved shall:

a. Have curb and gutter installed upon recommendation of the Town's Engineer and upon approval of the Board of Commissioners.

C. Existing Curb & Gutter Streets: All existing public streets that have curb, gutter and paving shall be maintained as required at the sole cost and expense of the Town unless they are on the NCDOT system.

D. Existing Dirt Streets

1. All dirt streets are to be improved at the expense of the abutting property owners or developer. These improvements can be caused by petition, Board of Commissioners order or as a requirement to obtain subdivision approval. Once approved, the Town will thereafter maintain the street at its sole cost and expense.

2. Existing dirt streets accepted by the Town prior to adoption of this policy shall be maintained as a dirt street at the sole expense of the Town.

3.6.4 UTILITY CUTS

A permit will be required for any utility company wishing to excavate or place utilities in the Town right-of-way. Pavement cuts in streets made by the utility company or the Town shall be repaired in either the following ways:

A. No. 57 stone shall be placed and vibrated on top of pipe to within 8-inches of the pavement surface after which 6-inches of B25.0B asphalt base and 2-inches of S9.5B asphalt is placed. All edges shall be over-excavated by 12-inches on each side of the cut and a 2-inch depth of S9.5B asphalt and 6-inches of B25.0B shall be placed in the remaining cut area. All pavement joints shall be tacked and sealed with an approved sealer. See Standard Detail 9.06.

B. Alternatively, the Contractor may backfill the cut with flowable fill concrete to within a minimum of 2 inches of the pavement surface (or match existing asphalt depth if greater than 2 inches in thickness) and top with a minimum of 2 inches of S 9.5B asphalt (or match existing thickness if greater than 2 inches). Excavatable flowable fill shall have a compressive strength of no less than 30 psi and no more than 100 psi. See Specification Section 02210, *Trenching, Backfilling, and Compaction of Utilities*, paragraph 2.1.5 for more information relating to flowable fill concrete.

C. Electric service shall not be installed until the street section is graded at final and approved.

3.6.5 USE OF EASEMENTS – HARD IMPROVEMENTS

All public easements including sewer, water, storm sewer and electric are to remain clear of obstructions. No buildings, fences, trees, shrubs or other obstructions shall be placed in any easement. However, fences may be allowed transversely but not longitudinally across utility easement with an approved encroachment permit. Fences across utility easements shall be required to provide a 12 foot vehicular gate. Driveways, walkways, asphalt and parking lots may be permitted in easements; however, the Town reserves the right to remove such asphalt, concrete, base course and sod as necessary to access its

facility in the case of emergency. Pavement or concrete will be replaced with a patch. Sod will be replaced with fescue or rye seeding. The Town will not be responsible for replacing a property owner's sod after repairing a utility line.

3.6.6 ACCEPTANCE OF PRIVATELY OWNED STREETS INTO THE PUBLICLY OWNED MAINTENANCE SYSTEM

This section offers an avenue for subdivisions who currently own and maintain all or a portion of their streets to transfer ownership of their streets to the Town of Wake Forest's publicly maintained street system. To protect the interest of the Town of WakeForest's citizens, all street acceptances must meet the following criteria at the sole costof the subdivision or its representative.

A. Eligibility

1. Residential;
2. A two-thirds majority of the homeowners agree or majority dictated by HOA guidelines, documented through a petition;
3. Residences must have off-street parking;
4. The streets must have been constructed after July of 2001. Private streets constructed prior to 2001 were not designed and constructed in compliance with the Design criteria consistent with Sections 3.1-3.5 of this Chapter; and
5. Any utilities under the pavement must be publicly maintained and in a Public Utility Easement (I.e. City of Raleigh Public Utilities Department), this shall be supported by necessary documentation from said utility provider.

B. Acceptance Process

All requests to dedicate one or more privately owned streets to the Town of WakeForest for public ownership and maintenance shall be subject to the following acceptance process outlined below.

Request a preliminary meeting with Community Development Department Staff to receive guidance on rights-of-way widths and limits, a representative (or designee) from a subdivision shall submit a written request for street acceptance to the Town of Wake Forest Community Development Department.

All requests shall be accompanied by the following items:

- A statement from the applicant acknowledging the Town's street acceptance policy and agreeing that all expenses are the responsibility of the HOA;
- One (1) full set of as-built drawings for all streets including elevations of storm drainage boxes, pipes, inverts and slopes signed by a Professional Engineer or Professional Land Surveyor;
- Copies of any BMP Operation and Maintenance agreements;

- Any Geotechnical Engineer reports, if available;
- Any landscape and tree installations;
- Any speed tables, speed bumps or speed humps must be removed and street must be restored to an even driving surface;
- All Street Signage must comply with the Manual of Uniform Traffic Control Devices (MUTCD);
- A walk-thru/inspection with the Town of Wake Forest Construction Inspector and Public Works Street Division representative;
- Any defects or deficiencies identified must be repaired by the HOA;
- Satisfy the warranty period identified in Section 3.6;
- The subdivision or its representative is responsible for surveying, plan preparation and recordation of the newly created public street; and
- Acceptance of the street into the publicly maintained street system by the Town of Wake Forest Board of Commissioners.

4 EROSION & SEDIMENTATION CONTROL

(last revised 7/1/14)

4.1 INTRODUCTION

The following section has been established to assist developers and engineers with the design, construction and maintenance of required erosion and sedimentation controls.

4.2 LAND DISTURBANCE PERMIT REQUIRED

NCDENR has delegated responsibility for administering the Sedimentation Control Program pursuant to the NC Sedimentation Pollution Control Act of 1974 (SPCA) to the Town of Wake Forest. All land disturbances within the jurisdiction of the Town of Wake Forest must comply with the following requirements.

Prior to commencing construction all approvals including plan approval and all permits and encroachments shall be obtained. Site grading only may be performed upon issuance of a Land Disturbance Permit from the Town of Wake Forest. All other construction must await the issuance of all remaining permits.

4.2.1 APPLICABILITY

A. A **Land Disturbance Permit** shall be required for all land-disturbing activities of **½ acre (21,780 sf)** or more in accordance with Section 15.7.2 of the Town of Wake Forest Unified Development Ordinance.

B. Single family lots being graded/built by the same builder/developer at the same time within the same subdivision, whether they are contiguous or noncontiguous, must obtain a Land Disturbance Permit if the total disturbance is ½ acre (21,780 sf) or greater.

4.2.2 STANDARDS

A. All land disturbing activities shall comply with the Town of Wake Forest Unified Development Ordinance, Section 12.3, "Erosion and Sedimentation Control Regulations" and the standards in this section.

B. All erosion and sediment control measures shall be designed in accordance with the North Carolina Erosion and Sediment Control Planning and Design Manual and the NCDENR Stormwater Best Management Practices Manual. These manuals contains valuable information and tools for developing plans to minimize soil erosion and prevent sedimentation pollution associated with land-disturbing activities, and are available online at:
http://portal.ncdenr.org/web/lr/publications
http://portal.ncdenr.org/web/lr/bmp-manual

C. All land disturbing activities shall comply with the National Pollutant Discharge Elimination System (NPDES) requirements NCDENR General Permit NCG01000 for Construction Activities.

4.2.3 LAND DISTURBANCE PERMIT

A. No person may initiate any land-disturbing activity on ½ acre of more before the following have been completed and approved by the Town of Wake Forest Engineering Department. Additional information is available online at:
http://www.wakeforestnc.gov/residents-engineering_erosionandsedimentcontrol.aspx

1. **Land Disturbing (E&SC) Permit Application** located at the end of this Section.
2. **Plan Checklist**
3. **Financially Responsible Owner (FRO) Form**
4. **Application Fee**
5. **E&SC Calculations**
6. **Stormwater Calculations**
7. **Deed**
8. **NCDENR DWR/ COE permit, as applicable**
9. **NCDOT Encroachment/Driveway permit, as applicable**
10. **Erosion and Sedimentation Control Plan** sealed by a NC registered Professional Engineer or Landscape Architect
11. **Vicinity map** showing the location of the site. The scale of the map shall be adequate to show the area in question with reasonable depiction of streets to determine the exact location of the site. The scale shall be no less than 1"=400'.
12. **USGS Quadrangle map** with the site location depicted on the map.
13. **NRCS Wake County Soil Survey** with the site location clearly depicted on the map.
14. **Drainage Area Map.** The drainage area contributing to the system being designed and the drainage sub-area contributing to each inlet point shall be clearly identified.

4.2.4 EROSION CONTROL DETAILS

Town of Wake Forest Concrete Washout Pit, Standard Detail 9.76, is herein made part of this section by reference and should be utilized in conjunction with the North Carolina Erosion and Sediment Control Planning and Design Manual.

4.3 GENERAL REQUIREMENTS

4.3.1 LAND DISTRUBANCE PERMIT NOTES

A. A Land Disturbance Permit is required for projects over 0.50 acre. If multiple lots with land disturbance over 0.50 acre total are either contiguous or non-contiguous in the same subdivision, being taken down by the same builder/Owner, a Land Disturbing Permit is required. The cost of the plan review and permit shall be determined according to the Town's Comprehensive List of Fees and Charges.

B. If additional acreage is added to an existing permit, revised forms, plans, and any additional fees must be submitted.

C. If ownership of a property has changed a revised Financial Responsibility Ownership (FRO) form must be submitted.

D. If a property is taken over by the bank, the bank shall contact the Town and repair all erosion control measures to Town/NCDENR standards. They shall also submit a new Financial Responsibility Ownership (FRO) form.

E. If a project is not complete within two years, the plans must be renewed at the renewal cost established in the Town's Comprehensive List of Fees and Charges. A

revised set of plans may be submitted if acreage has already been developed and a certificate of occupancy has been issued.

F. An **erosion preconstruction meeting** must be held with the Town of Wake Forest prior to start of any work, including installation of erosion control measures, demolition, cutting trees, and grubbing. Contractor to contact Town of Wake Forest Engineering at 919.435.9443 to set up a meeting. All plans must be signed and copies returned back to the Town one week prior to preconstruction meeting.

G. The Financial Responsibility Owner, general contractor, grading company, and erosion control installer must be present at the preconstruction meeting.

H. The **Land Disturbance Permit** and NPDES general stormwater permit will be given out at this meeting.

I. After the preconstruction meeting is held, the Contractor can **install initial erosion control measures only**. This includes but is not limited to construction entrance, silt fence, perimeter diversion ditch, check dams (rock or waddle type), tree protection fence, existing inlet protection, skimmer sediment basins, and sediment traps. Clear only as necessary to install these measures.

J. Cutting trees prior to issuing the permit will not be allowed.

K. Contractor is responsible for E&SC weekly installation and maintenance log including dates of temporary/permanent ground cover, a rain gage, copy of Town of Wake Forest signed plans onsite, revised signed plans, NPDES log, and construction box must be present and easily accessible onsite.

L. Once measures are installed, **Contractor/Financial Responsibility Owner shall call the Town of Wake Forest for an initial inspection**. If site passes inspection, a certificate of compliance will be issued. The Contractor can then being clearing, grubbing, and grading.

M. Contractor to maintain access road for emergencies at all times.

N. Phase project to leave as little ground open as possible.

O. Temporarily seed, straw and tack or hydroseed within 7-14 days of any phase of grading, including slopes. Seed basins and ditches immediately after construction. Refer to seeding schedule chart in Section 12.3.3.E of the UDO.

P. **Prior to removal of temporary measures**, Town must approve removal. All areas draining to temporary measure must have 75% permanent ground cover.

Q. Town construction inspector will evaluate the site at least once a month. A copy of the inspection form will be emailed to the Financially Responsible Owner. The weekly erosion log and NPDES log must be onsite and available for review.

R. If the site is found out of compliance a Notice of Violation will be issued giving the Contractor/ Financially Responsible Owner 10 working days to remedy the problem. If the situation is not resolved within that time period, a fine may be issued according to the Town's Comprehensive List of Fees and Charges.

S. If sediment leaves the site a fine may be issued according to the Town's Comprehensive List of Fees and Charges. If sediment enters a buffer, stream, or wetland, NCDENR Division of Energy, Mineral and Land Resources will be notified and may issue fines.

T. Call the Town upon completion for a **final erosion inspection**. A punch list may be generated addressing any remaining items. There must be 75% groundcover on the entire site prior to a certificate of occupancy. If the site is found to be in

compliance an **erosion certificate of completion** will be issued.

4.3.2 CONSTRUCTION SEQUENCING

A. A **Preconstruction meeting** must be held prior to installation of measures and construction. Contact Town of Wake Forest Engineering Department at 919.435.9443 to set up a meeting. The Land Disturbing Permit will be issued at the meeting, NPDES stormwater permit and plan review.

B. Cutting trees prior to issuing the permit will not be allowed.

C. Installation of initial measures only (silt fence, construction entrance, tree protection fence and sediment basins) must be installed first. No grading or grubbing may take place other than to install the measures.

D. Initial inspection conducted by Town. Please call for inspection 919.435.9531 prior to clearing, grubbing or grading. A certificate of compliance will be issued upon approval of initial measures.

E. Grading may now begin. No mass grading is allowed. Please follow the phased sequence of construction outlined on the plans. If the plans need revision, please notify the Town and design Engineer prior to starting work. If work is conducted that is not shown on the approved set of plans, it may result in an NOV or fine/violation.

F. Installation of roads for safe access must be established prior to construction of buildings for emergency access purposes.

G. Owner is responsible for inspecting measures weekly and within 24 hours after every ½" of rainfall. A rain gage must be onsite along with a copy of the signed plans per the NPDES Stormwater Permit. A designated subcontractor may be in charge of inspections but must still have proper NCDOT Erosion Level I/II Certification Training.

H. An additional erosion measure self inspection must be conducted outlining installation and maintenance of erosion control measures including seeding operations. A chart will be provided for the Owner/Representative to fill out on a daily basis including date of installation, maintenance and repair. This chart will also include a location to put turbidity levels in NTU's at all outlet points. This chart must be kept onsite at all times.

I. Monthly inspections will be conducted by the Town (at a minimum). The Town will give the Owner a copy of the inspection report and notify them of any issues that the site may have.

J. If an NOV is issued, the site issues will need to be addressed as per the NOV (Notice of Violation) letter but no later than ten calendar days. If the NOV is not addressed, fines may be issued according to the Town's Comprehensive List of Fees and Charges.

K. If three NOV's are issued on one construction site to the same Owner/Contractor, a stop work order will be issued and re-education/training must be conducted and verification of training must be presented to the Town prior to re-starting work.

L. Any mud tracked into the street must be cleaned up immediately. If the mud/dirt is not addressed in a timely manner, the Contractor will be assessed a fine according to the Town's Comprehensive List of Fees and Charges.

M. If sediment leaves the site into a water course, natural area, or wetland an automatic fine will be issued according to the Town's Comprehensive List of Fees and

Charges. In addition, NCDENR will be automatically notified and additional fines may be assessed.

N. Grading prior to issuing the permit or without a permit will result in a fine according to the Town's Comprehensive List of Fees and Charges, plus any additional permit review fees.

O. Seed the project as work progresses within 14 calendar days of any phase of grading and within 10 days of final completion.

P. Upon completion the project must be 85% built out to accept erosion control, streets, stormwater, etc., and have 75% permanent grass coverage. A final inspection will be conducted where a punchlist may be generated to aid the Contractor in project close out.

Q. Final PE certified As-Builts must be submitted to the Town for stormwater pipes (invert and top elevations, pipe length, and pipe slope), private and public basins, level spreaders, stormwater facilities, greenways/trails, recorded easements, NCDOT acceptance, roadway cores, soil compaction tests, maintenance and operation agreements, etc. See Appendix B, Section 2.

R. A Certificate of Completion will be issued at final project close out when all paperwork has been received and all measures installed/removed as per plan. This certificate will close out the erosion control permit. A temporary certificate of occupancy may be permitted prior to the final certificate of completion. The bond will be released upon issuance of certificate of completion for the erosion control permit.

4.4 FEES AND INSPECTIONS

4.4.1 FEES

A. Fees for the administration of the Town's erosion and sedimentation control regulations are due upon initial submittal of construction plans. Any resubmittal of a Land Disturbance Permit application shall require the same permit fees as were paid in the original application. Any renewal of a Land Disturbance Permit for a project that is under construction but not completed within two (2) years of the original Land Disturbance Permit issuance shall require fees to be paid based upon the Town's Comprehensive List of Fees and Charges.

4.4.2 INSPECTIONS

A. Agents and officials of the Town will monthly (at a minimum) inspect land-disturbing activities to ensure compliance with the Act, this ordinance, or rules or orders adopted or issued pursuant to this article, and to determine whether the measures required in the Plan are effective in controlling erosion and sedimentation resulting from land-disturbing activity. Notice of the right to inspect shall be included in the certificate of approval of each Plan.

B. The Town has the power to conduct such investigations as it may reasonably deem necessary to carry out its duties as prescribed in this article, and for this purpose to enter at reasonable times upon any property, public or private, for the purpose of investigating and inspecting the sites of any land-disturbing activity. No person may refuse entry or access to any authorized representative or agent for the Town who requests entry for purposes of inspections, and presents appropriate credentials, nor may any person obstruct, hamper, or interfere with any such representatives while in the process of carrying out their official duties.

C. A Certificate of Compliance for Preliminary Soil Erosion and Sedimentation Control must be issued indicating that initial soil erosion and sedimentation controls have been installed. This certificate must be issued prior to the approval by the Town of an application for building construction in the Town, in any of the incorporated areas of the Town, or extraterritorial jurisdictional areas of the Town subject to the erosion and sedimentation control regulations of this article.

D. A Certificate of Completion must be issued when inspections indicate that all conditions of the approved land disturbance permit are met and all disturbed areas are stabilized with permanent ground cover, permanent armor, or impervious surface. All proposed roads, utilities, permanent erosion control devices, and other infrastructure has been installed as per approved plans. All temporary sediment control devices required by the approved plan are removed.

E. Once a Certification of Completion is issued on an approved plan involving a proposed public road dedication and a petition for North Carolina Department of Transportation acceptance is submitted to Administrator, notification must be mailed to the North Carolina Division of Highways District 1 Office detailing that the project has been issued a Certification of Completion. This notification should describe the project in detail with publicly dedicated streets described by name and approximate length.

F. Any land disturbing activity will be the responsibility of the individual building lot owners, and failure to control project against off site damage as documented by the Town's authorized representative will be deemed a violation of the erosion and sedimentation control regulations of this article.

1. A driveway with a minimum 10 foot wide by 30 foot long (with filter fabric underneath) gravel construction pad or equal will be required, in addition to the installation of silt fence on the low sides of the lot and tree protection around the remaining sides, for each building lot when the initial footing inspection is conducted by the Engineering Construction Inspectors.
2. For single family residential lots, the construction entrance shall be a minimum of 12 feet wide by 30 feet long with filter fabric underneath that meets ASTM D 4632 standards and has a 200 pound grab tensile strength.
3. The Town of Wake Forest Department of Engineering will approve the type of silt fence that will be accepted.
4. Seeding and mulching of any applicable disturbed area is required. Areas within 25 feet of the edge of pavement or gravel of the road must be stabilized before the issuance of a Certificate of Occupancy. Each lot must have 75% germinated seed coverage prior to a CO and have positive drainage on all sides.
5. Any erosion or stormwater issues on individual lots will be the responsibility of the builder for a one year period after house is sold.

G. The Town may require written statements, or the filing of reports under oath, with respect to pertinent questions relating to land-disturbing activity.

H. If through inspections the Town determines that significant erosion or sedimentation is occurring as a result of land-disturbing activity, despite application and maintenance of protective measures, the person conducting the land-disturbing activity will be required by the Administrator to take additional protective action.

4.5 VIOLATION FEE LIST

Fees for violations shall be assessed according the Town's Comprehensive List of Fees and Charges.

4.6 LAND DISTURBING (E&SC) PERMIT APPLICATION, CHECKLIST & FRO

As described in Section 4.2.3, the following Land Disturbing (E&SC) Permit Application Plan Checklist, and Financially Responsible Owner (FRO) Form shall be used for all projects with the jurisdiction of the Town of Wake Forest.

For TOWF Use Only	Application #:
Project Name:	
Date Received: _____	Acres:
Date Approved:	Fees Paid:

TOWN *of* WAKE FOREST

LAND DISTURBING (E&SC) PERMIT APPLICATION, PLAN CHECKLIST, & FINANCIALLY RESPONSIBLE OWNER (FRO) FORM

NO PERSON MAY INITIATE ANY LAND-DISTURBING ACTIVITY ON 1/2 ACRE OR MORE BEFORE THESE FORMS, FEES, AND AN EROSION AND SEDIMENTATION CONTROL PLAN SEALED BY A NORTH CAROLINA REGISTERED PROFESSIONAL ENGINEER OR LANDSCAPE ARCHITECT HAVE BEEN COMPLETED AND APPROVED BY THE TOWN OF WAKE FOREST. MULTIPLE SINGLE FAMILY LOTS THAT DISTURB MORE THAN ½ ACRE ALSO REQUIRE A PERMIT AND SHALL FOLLOW THE STANDARD PROCEDURES OUTLINED BELOW. SEE THE UNIFIED DEVELOPMENT ORDINANCE FOR ADDITIONAL INFORMATION AND FULL ORDINANCE REGULATIONS.

NOTE: THE APPLICATION FEE OF $500.00 PER ACRE (ROUNDED UP TO THE NEXT ACRE I.E.: 1.1 ACRES = 2 ACRES* $500 = $1,000) IS DUE AT TIME OF SUBMITTAL. IF FEES ARE NOT SUBMITTED THE PLAN WILL AUTOMATICALLY BE DISAPPROVED.

DISCLAIMER: TOWN OF WAKE FOREST FEES AND CHARGES ARE SUBJECT TO CHANGE WITHOUT NOTICE. PLEASE CALL 919-435-9443 TO CONFIRM CURRENT FEES AND CHARGES.

PART A: PROJECT INFORMATION

PROJECT NAME_____

1. TAX PIN NUMBER_____
2. ZONING_____
3. LOCATION/ADDRESS OF TRACT_____

4. SUBDIVISION_____ LOT#_____

5. DEED BOOK _____ PAGE_____

*PLEASE PROVIDE A COPY OF THE MOST CURRENT DEED

6. PURPOSE OF DEVELOPMENT_____

7. TOTAL NUMBER OF UNITS_____

8. PERCENT IMPERVIOUS SURFACE_____

9. TOTAL TRACT ACREAGE:_____

10. TOTAL ACREAGE DISTURBED (INCLUDING OFF-SITE UTILITIES AND ROADWORK):_____

11. AMOUNT OF FEE ENCLOSED:

ROUNDED UP ACREAGE_____ * $500/ACRE = $_____

CHECK NUMBER_____

DATE PAID _____

DISCLAIMER: Town of Wake Forest fees and charges are subject to change without notice. Please call 919-435-9443 to confirm current fees and charges.

12. PROPERTY OWNER(S) (PROVIDE LIST OF ADDITIONAL PROPERTY OWNERS ON AN ATTACHED SHEET):

NAME_____ E-MAIL _____

ADDRESS_____

PHONE_____ CELL _____

13. PERSON TO CONTACT SHOULD EROSION AND SEDIMENT CONTROL ISSUES ARISE DURING LAND-DISTURBING ACTIVITY:

NAME_____ E-MAIL _____

ADDRESS_____

PHONE_____ CELL _____

14. PLANS PREPARED BY_____

ADDRESS_____

EMAIL_____

PHONE_____ CELL _____

15. DOCUMENTS SUBMITTED (SUBMITTER TO PLACE A CHECK MARK IN THE BOX):

FEES ($500 per acre rounded up, due upon 1st review)	
FINANCIAL RESPONSIBILITY OWNER FORM	
COMPLETED PLAN CHECKLIST	
PLANS (to be submitted with construction set)	
E&SC CALCULATIONS (1 copy)	
STORMWATER CALCULATIONS (1 copy)	
MAINTENANCE AND OPERATION AGREEMENT	
NCDOT Encroachment/Driveway Permit	
DWQ 401 Permit	
USACOE 404 Permit	
NCG010000 Permit COC	
EROSION & SEDIMENT CONTROL SURETY	

APPROXIMATE DATE LAND-DISTURBING ACTIVITY WILL COMMENCE: _____

THE SOIL EROSION AND SEDIMENTATION CONTROL PLAN, supporting documents, maps and computations submitted for the above tract conform to the requirements of all applicable sections of the Town of Wake Forest Erosion & Sedimentation Control Ordinance outlined in the UDO.

_____

SIGNATURE TITLE DATE

PART B. FINANCIALLY RESPONSIBLE OWNER (FRO)/PERSONS INFORMATION

1. PERSON(S) OR FIRMS WHO ARE FINANCIALLY RESPONSIBLE FOR THE LAND-DISTURBING ACTIVITY (PROVIDE A COMPREHENSIVE LIST OF ALL RESPONSIBLE PARTIES ON AN ATTACHED SHEET):

_____ _____
NAME EMAIL

_____
ADDRESS

_____
CITY STATE ZIP CODE

_____ _____
PHONE CELL

2. IF THE FINANCIALLY RESPONSIBLE PARTY IS NOT A RESIDENT OF NORTH CAROLINA, GIVE NAME AND STREET ADDRESS OF THE DESIGNATED NORTH CAROLINA AGENT:

_____ _____
NAME EMAIL

_____
ADDRESS

_____
CITY STATE ZIP CODE

_____ _____
PHONE CELL

IF THE FINANCIALLY RESPONSIBLE PARTY IS A PARTNERSHIP OR OTHER PERSON ENGAGING IN BUSINESS UNDER AN ASSUMED NAME, **ATTACH A COPY OF THE CERTIFICATE OF ASSUMED NAME.** IF THE FINANCIALLY RESPONSIBLE PARTY IS A CORPORATION, GIVE NAME AND STREET ADDRESS OF THE REGISTERED AGENT:

_____ _____
NAME OF REGISTERED AGENT E-MAIL ADDRESS

_____
ADDRESS

_____
CITY STATE ZIP

_____ _____

PHONE FAX

The above information is true and correct to the best of my knowledge and belief and was provided by me under oath (This form must be signed by the Financially Responsible Person if an individual or his attorney-in-fact, or if not an individual, by an officer, director, partner, or registered agent with the authority to execute instruments for the Financially Responsible Person). I agree to provide corrected information should there be any change in the information provided herein.

_____ _____

NAME TITLE OR AUTHORITY

_____ _____

SIGNATURE DATE

I, _____, a Notary Public of the County of

_____, State of North Carolina, hereby certify that

_____ appeared personally before me this day and being duly sworn acknowledged that the above form was executed by him.

Witness my hand and notarial seal, this _____day of _____, 20_____

_____

Notary

My commission expires_____

TOWN *of* WAKE FOREST

LAND DISTURBING (E&SC) PERMIT PLAN SUBMITTAL CHECKLIST

(SUBMITTER TO PLACE A CHECK MARK NEXT TO EACH ITEM)

- ☐ 1. LOCATION/VICINITY MAP
- ☐ 2. EXISTING AND PROPOSED COUNTOURS, INCLUDING OFFSITE
- ☐ 3. CLEARLY DELINEATED BOUNDARIES OF LAND DISTURBANCE WITH ACREAGE
- ☐ 4. SOILS AREA MAP
- ☐ 5. DRAINAGE AREA MAP
- ☐ 6. EXISTING UTILITY EASEMENTS, STORM DRAINAGE, BASINS, LEVEL SPREADERS
- ☐ 7. EXISTING LOT LINES, LOT NUMBERS, SURROUNDING PROPERTY OWNERS
- ☐ 8. STREAM CENTERLINES, STREAM BUFFERS, WETLANDS, FLOODPLAINS
- ☐ 9. TEMPORARY EROSION CONTROLS TO BE SHOWN ON PLANS:
  - ☐ 1. EROSION CONTROL CALCULATIONS (SEDIMENT BASIN, SEDIMENT TRAP, SKIMMER, DITCH, ETC...)
  - ☐ 2. SKIMMER BASINS REQUIRED FOR DRAINAGE AREA OVER 5 ACRES
  - ☐ 3. IF PAM IS TO BE USED ONSITE FOR ANY APPLICATIONS, CALCULATIONS FOR APPLICATION RATES AND SPECIFICATIONS MUST BE SHOWN. IN ADDITION, SOIL TESTS MUST BE TAKEN TO DETERMINE CORRECT SOIL CHARGE AND PRODUCT TYPE PRIOR TO USE.
  - ☐ 4. CONSTRUCTION ENTRANCE 50 FOOT MINIMUM WITH WOVEN 20 # TENSILE STRENGTH FABRIC UNDERNEATH
  - ☐ 5. SILT FENCE – METAL POSTS WITH WIRE SPACED AT 6 FEET
  - ☐ 6. HARDWARE CLOTH OUTLETS (SPECIAL SEDIMENT CONTROL FENCE)
  - ☐ 7. TREE PROTETION FENCE WITH “DO NOT ENTER TREE PROTECTION AREA” SIGN IN ENGLISH AND SPANISH
    - i. REQUIRED AROUND PERIMETER OF PROPERTY

ii. REQUIRED AT BUFFER ZONES
iii. REQUIRED IN TREE SAVE AREAS (AROUND DRIP LINE)

☐ 8. DIVERSION DITCHES

☐ 9. INLET PROTECTION

☐ 10. EROSION

☐ 11. PERMANENT EROSION/STORMWATER CONTROLS

i. STORMWATER CALCULATIONS, Q PRE, Q POST, % IMPERVIOUS
ii. PROPOSED STORMWATER EASEMENTS (RECORDED)
iii. MAINTENANCE AND OPERATION AGREEMENT
iv. PROFESSIOANLLY SURVEYED AND ENGINEER STAMPED AS-BUILTS OF STORMWATER PONDS/BIO CELLS, LEVEL SPREADERS, STORM DRAINAGE INVERTS, TOPS, GRATES, SLOPES, LENGTH, SIZE, ETC…
v. PERMANENT DITCHES WITH MATTING

☐ 10. EROSION PERMIT NOTES: (please add to plans)

1. A LAND DISTURBING (E&SC) PERMIT IS REQUIRED FOR PROJECTS OVER 0.50 ACRE.

   IF MULTIPLE LOTS WITH LAND DISTURBANCE OVER 0.50 ACRE TOTAL ARE EITHER CONTIGUOUS OR NON-CONTIGUOUS IN THE SAME SUBDIVISION, BY THE SAME BUILDER/OWNER, A LAND DISTURBING PERMIT IS REQUIRED.

   THE COST OF THE PLAN REVIEW AND PERMIT IS $500/ACRE ROUNDED UP (1.1 ACRES = 2 ACRES @ $500/ACRE = $1,000). THE FEE IS DUE AT TIME OF PLAN SUBMITTAL. DEVELOPER IS RESPONSIBLE FOR INFORMING BUILDER OF E&SC PERMIT REQUIREMENTS ON INDIVIDUAL LOTS.

   DISCLAIMER: Town of Wake Forest fees and charges are subject to change without notice. Please call 919-435-9443 to confirm current fees and charges.

2. IF ADDITIONAL ACREAGE IS ADDED TO AN EXISTING PERMIT REVISED FORMS, PLANS, AND ANY ADDITIONAL FEES MUST BE SUBMITTED.

3. IF OWNERSHIP OF A PROPERTY HAS CHANGED A REVISED FRO MUST BE SUBMITTED.

4. IF A PROPERTY IS TAKEN OVER BY THE BANK, THE BANK SHALL CONTACT THE TOWN AND REPAIR ALL EROSION CONTROL MEASURES TO TOWN/NCDENR STANDARDS. THEY SHALL ALSO SUBMIT A NEW FRO FORM.

5. IF A PROJECT IS NOT COMPLETE WITHIN TWO YEARS, THE PLANS MUST BE RENEWED AT $250/ACRE. A REVISED SET OF PLANS MAY BE SUBMITTED IF ACREAGE HAS ALREADY BEEN DEVELOPED AND A CERTIFICATE OF OCCUPANY HAS BEEN ISSUED.

6. AN EROSION PRECONSTRUCTION MEETING MUST BE HELD WITH THE TOWN OF WAKE FOREST PRIOR TO START OF ANY WORK, INCLUDING INSTALLATION OF EROSION CONTROL MEASURES, DEMOLITION, CUTTING TREES, AND GRUBBING.

   CALL ENGINEERING AT (919) 435-9443 TO SET UP A MEETING. ALL PLANS MUST BE SIGNED AND COPIES RETURNED TO THE TOWN 1 WEEK PRIOR TO PRECONSTRUCTION MEETING.

7. THE OWNER, GENERAL CONTRACTOR, GRADING COMPANY, AND EROSION CONTROL INSTALLER MSUT BE PRESENT AT THE PRECONSTRUCITON MEETING.

8. THE E&SC PERMIT WILL BE DISTRIBUTED AT THIS MEETING.

☐ 11. E&SC CONSTRUCTION SEQUENCE NOTES: (please add to plans)

1. PRIOR TO SCHEDULING THE PRECONSTRUCTION MEETING, THE EROSION AND SEDIMENT CONTROL SURETY MUST BE SUBMITTED TO THE TOWN OF WAKE FOREST. THE NCG010000 CERTIFICATE OF COVERAGE MUST BE OBTAINIED BY THE PERMITTEE, WHEN APPLICABLE. A COPY OF THE COC MUST BE SUBMITTED TO THE TOWN.
2. AFTER THE PRECONSTRUCITON MEETING IS HELD, THE CONTRACTOR CAN INSTALL INITIAL EROSION CONTROL MEASURES ONLY. THIS INCLUDES BUT IS NOT LIMITED TO CONSTRUCTION ENTRANCE, SILT FENCE, PERIMETER DIVERSION DITCH, CHECK DAMS (ROCK OR WADDLE TYPE), TREE PROTECTION FENCE, EXISITNG INLET PROTECTION, SKIMMER SEDIMENT BASINS, AND SEDIMENT TRAPS. CLEAR ONLY AS NECESSARY TO INSTALL THESE MEASURES.
3. CONTRACTOR IS RESPONSIBLE FOR E&SC WEEKLY INSTALLATION AND MAINTENANCE LOG INCLUDING DATES OF TEMPORARY/PERMANENT GROUND COVER, A RAIN GAUGE, COPY OF TOWF SIGNED PLANS ONSITE, REVISED SIGNED PLANS, NPDES LOG, AND CONSTRUCTION BOX MUST BE PRESENT AND EASILY ACCESSABLE ONSITE.
4. ONCE MEASURES ARE INSTALLED, CONTRACTOR/FRO TO CALL TOWF FOR AN INITIAL INSPECTION. IF SITE PASSES INSPECTION, A CERTIFICATE OF COMPLIANCE WILL BE ISSUED. CONTRACTOR CAN NOW BEING CLEARING, GRUBBING, AND GRADING.
5. CONTRACTOR TO MAINTAIN ACCESS ROAD FOR EMERGENCIES AT ALL TIMES.
6. PHASE PROJECT TO LEAVE AS LITTLE GROUND OPEN AS POSSIBLE.
7. TEMPORARILY SEED, STRAW AND TACK OR HYDROSEED WITHIN 14 DAYS OF ANY PHASE OF GRADING, INCLUDING SLOPES. SEED BASINS AND DITCHES IMMEDITEALY AFTER CONSTRUCTION.
8. PRIOR TO REMOVAL OF TEMPORARY MEASURES, TOWN MUST APPROVE REMOVAL. ALL AREAS ABOVE TEMPORARY MEASURE MUST HAVE 85% GROUND COVER.
9. THE TOWN OF WAKE FOREST CONSTRUCTION INSPECTOR WILL EVAULATE THE SITE ATLEAST ONCE A MONTH. A COPY OF THE INSPECTION FORM WILL BE EMAILED TO THE FRO. THE WEEKLY EROSION LOG AND NPDES LOG MUST BE ONSITE AND AVAILABLE FOR REVIEW.
10. IF THE SITE IS FOUND OUT OF COMPLIANCE A NOTICE OF VIOLATION WILL BE ISSUED GIVING THE CONTRACTOR/FRO 7 WORKING DAYS TO REMEDY THE PROBLEM. IF THE SITUATION IS NOT RESOLVED WITHIN THE TIME PERIOD A FINE MAY BE ISSUED.
11. IF SEDIMENT LEAVES THE SITE A FINE MAY BE ISSUED UP TO $5,000 PER DAY

PER VIOLATION. IF SEDIMENT ENTERS A BUFFER, STREAM, OR WETLAND NCDWQ WILL BE NOTIFIED. THEY MAY ISSUE FINES UP TO $25,000 PER DAY PER VIOLATION.

12. CALL THE TOWN UPON COMPLETION FOR A FINAL EROSION INSPECTION. A PUNCHLIST MAY BE GENEREATED ADDRESSING ANY REMAINING ITEMS. THERE MUST BE 85% GROUNDCOVER ON THE ENTIRE SITE PRIOR TO A CERTIFICATE OF OCCUPANCY. IF THE SITE IS FOUND TO BE IN COMPLIANCE AN EROSION CERTIFICATE OF COMPLETION WILL BE ISSUED. AFTER THE COMPLETION OF THE PROJECT, SUBMIT A NOTICE OF TERMINATION TO END COVERAGE UNDER THE NCG01000 PERMIT.

Landscape Design & Installation

5.1 INTRODUCTION

The following section has been provided to assist developers and engineers with the design and installation of landscaping and buffers required by the Wake Forest Unified Development Ordinance (UDO).

5.2 OFFICIAL PLANTING LIST

The Urban Forestry Board has been assigned the responsibility to maintain, update, and make publicly available the Official Planting List for the Town Wake Forest. The Official Planting List describes the species of trees, shrubs, and other plant materials which may be planted in order to satisfy the requirements of the UDO. It also provides the appropriate spacing for each species and the specific uses for which credit will be permitted. No species other than those included in the Official Planting List may be planted as street trees without the written permission of the Urban Forestry Board.

5.3 PLANTING DESIGN AND INSTALLATION

Figure 5.1 – Critical Root Zone

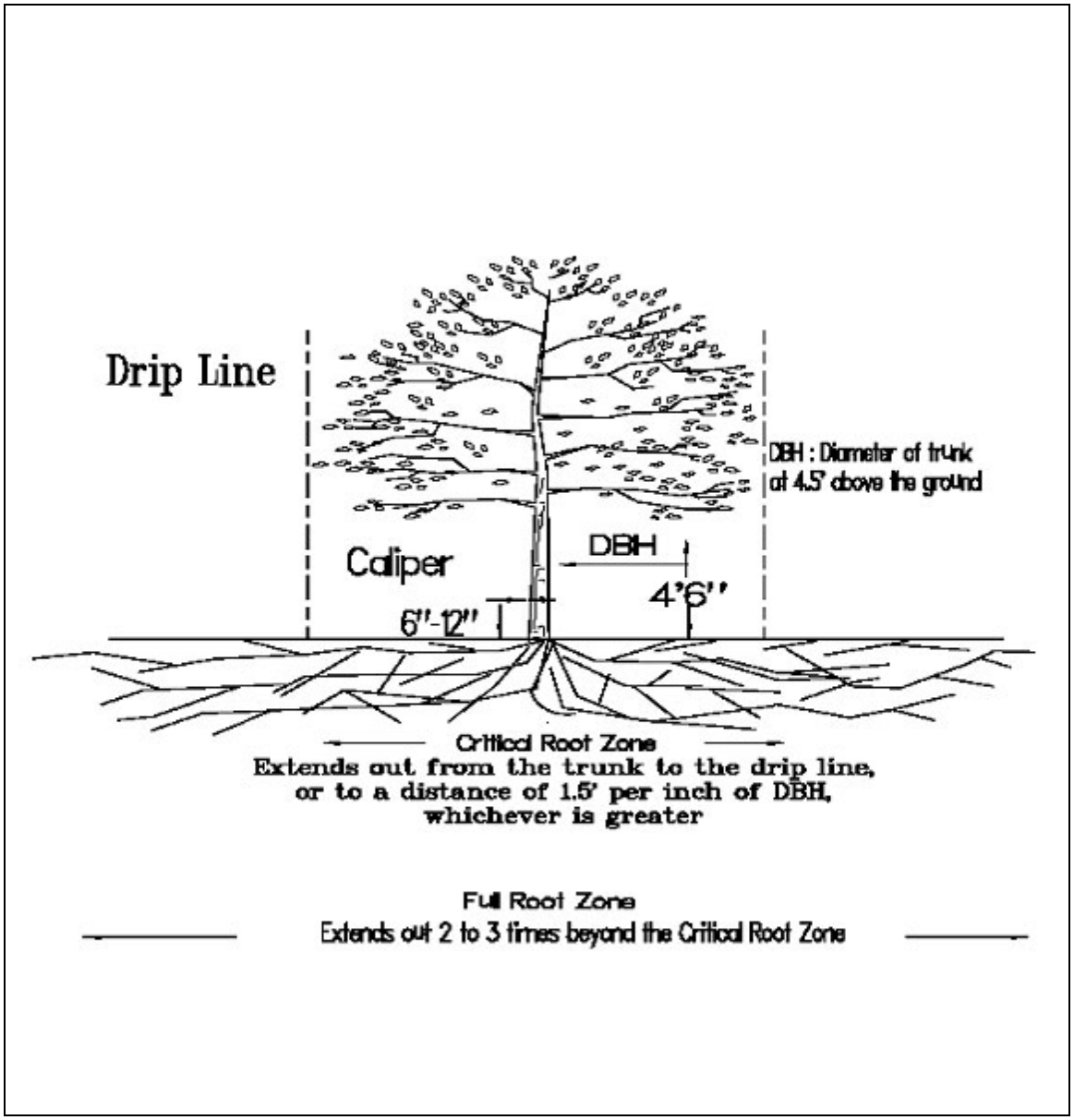


Figure 5.2 – Standard Tree Protection Detail

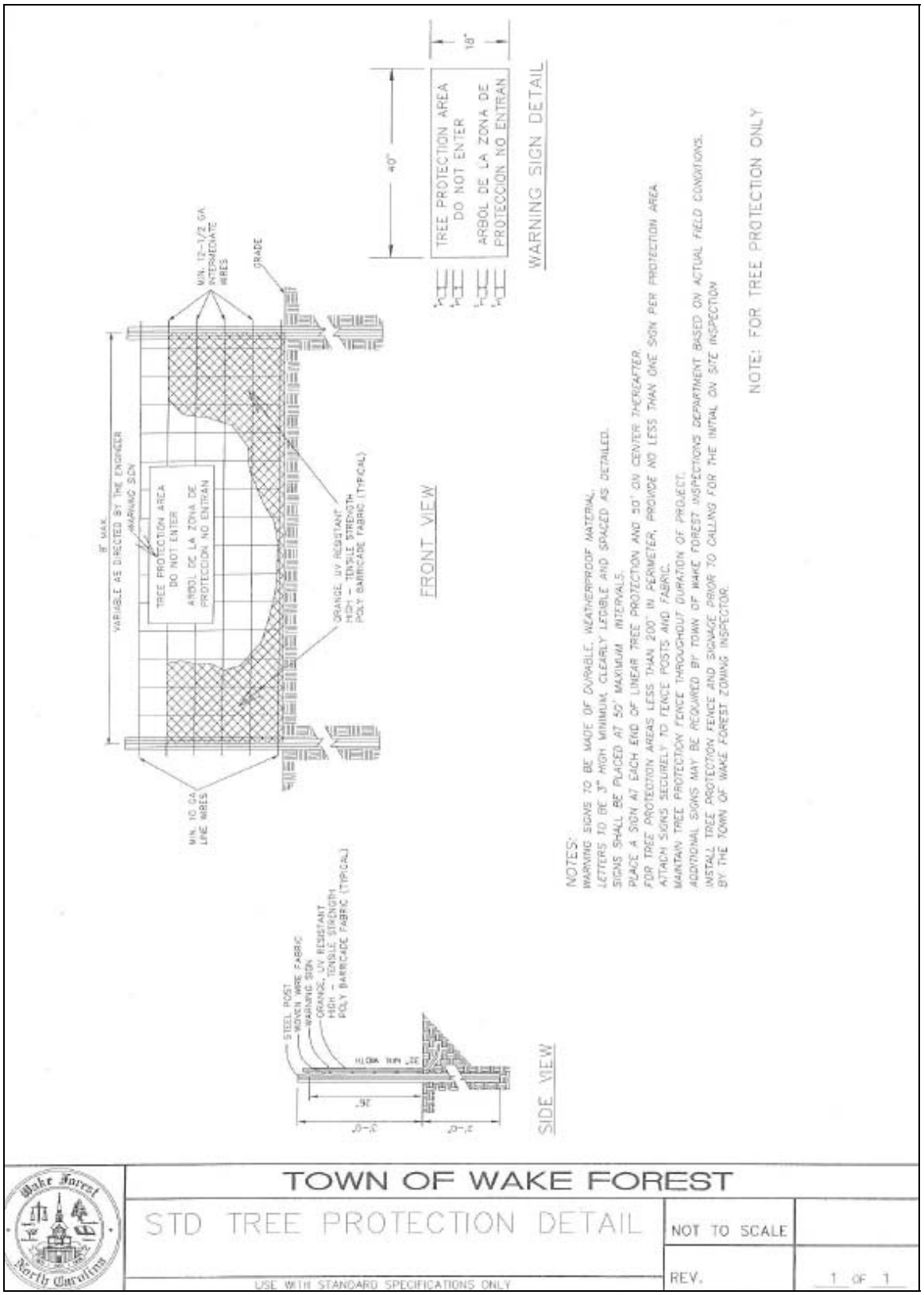


Figure 5.3 – Excavation for Utilities

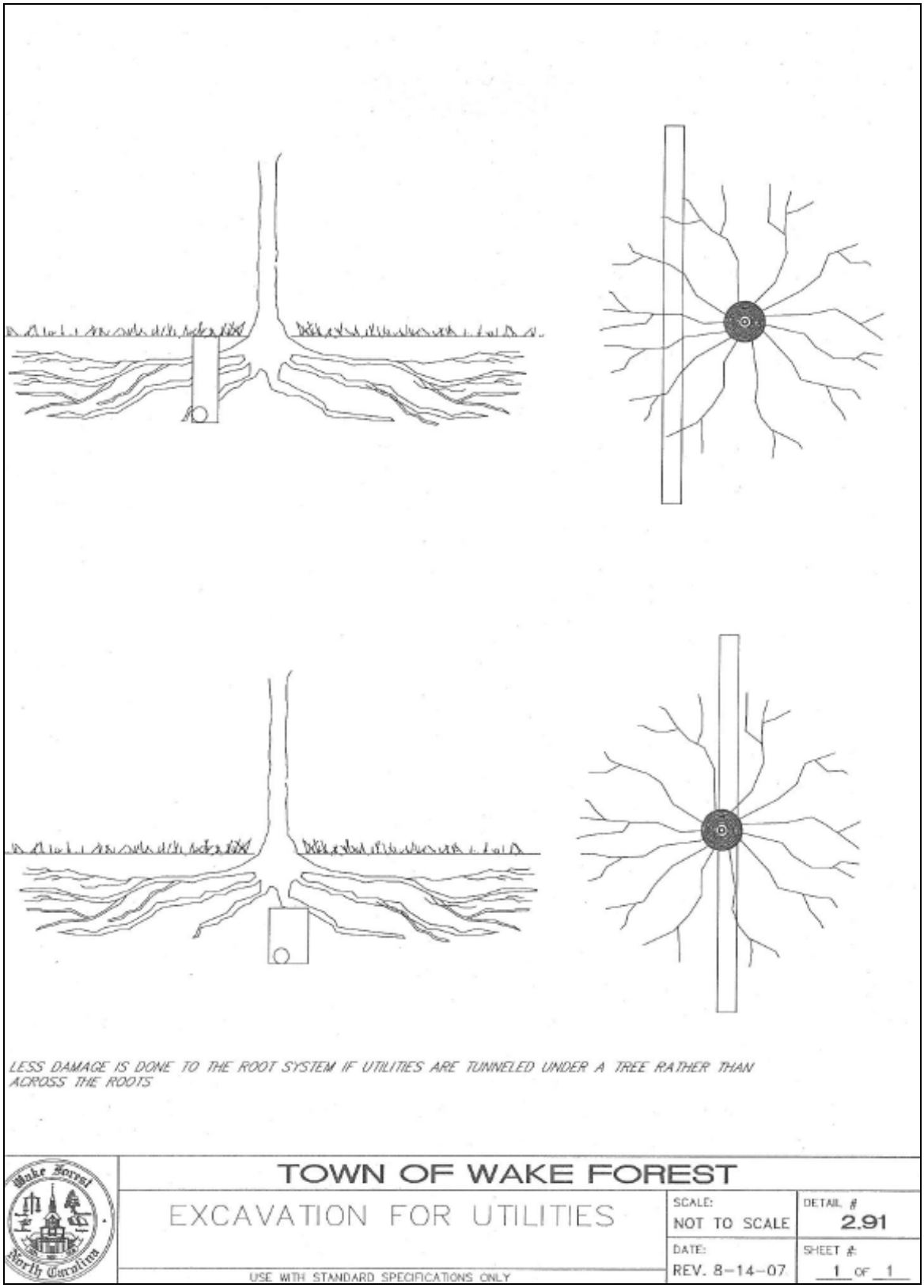


Figure 5.4 – Tree Surgery Detail

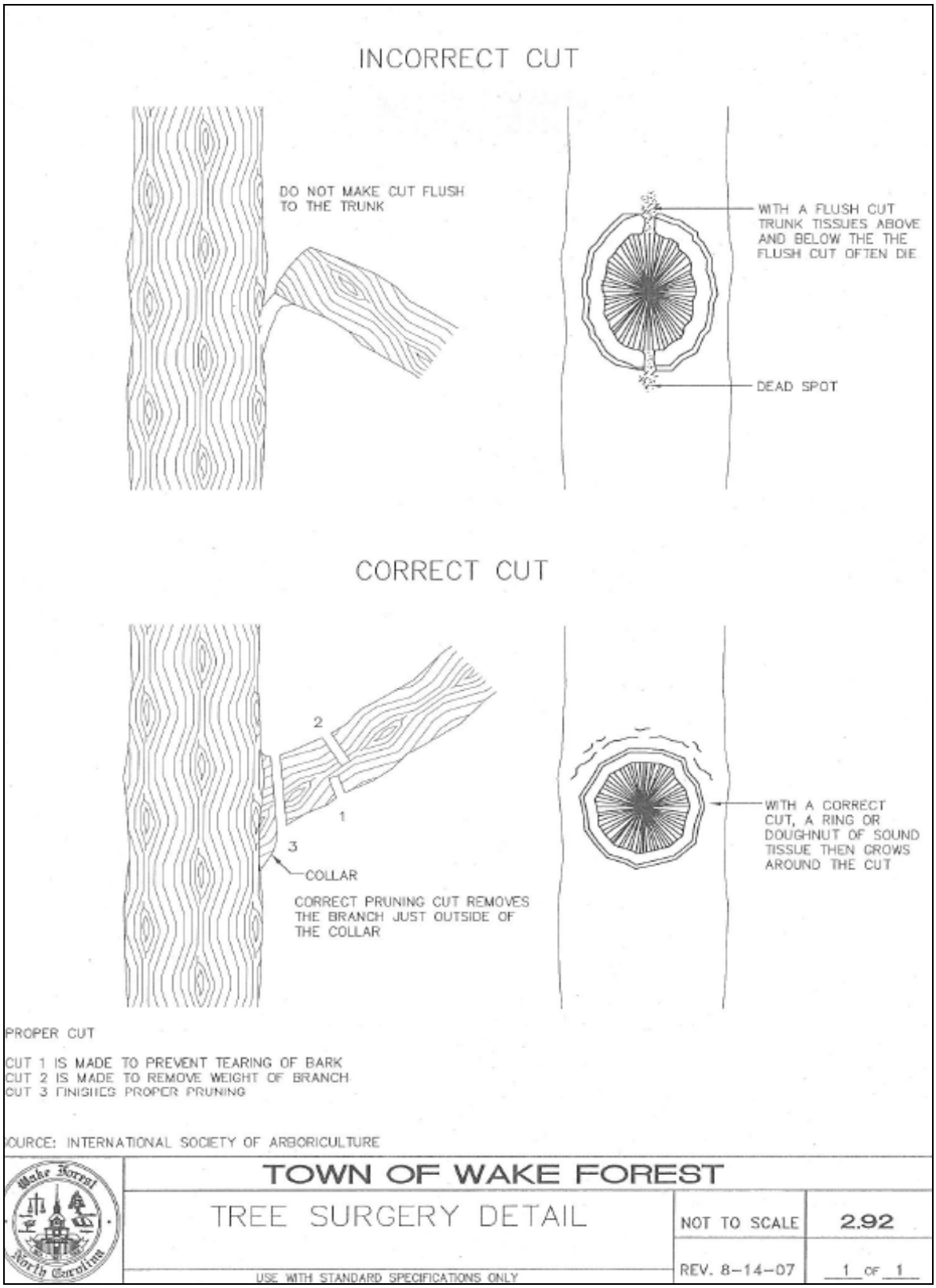


Figure 5.5 – Typical Tree Planting Detail

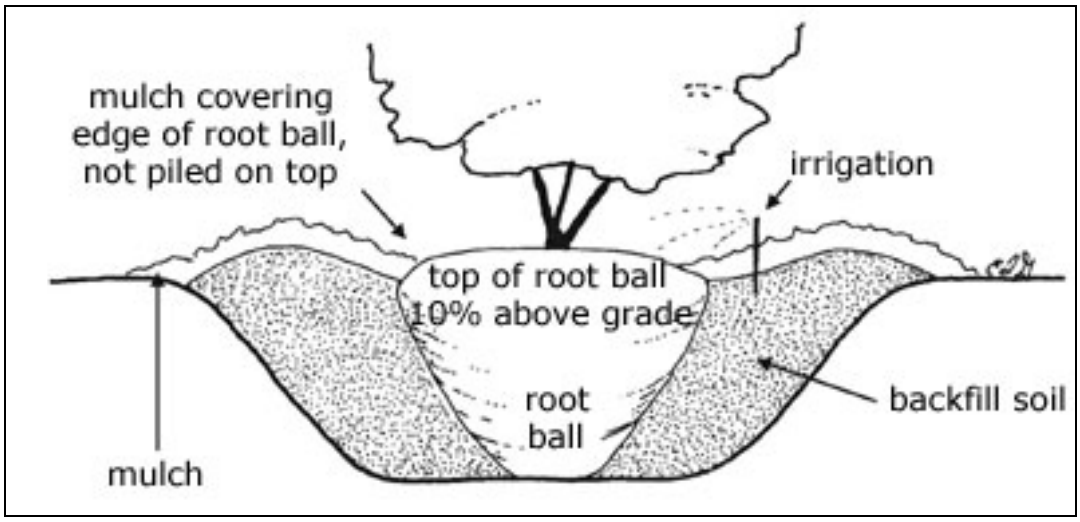


Figure 5.6 – Preferred Staking Methods

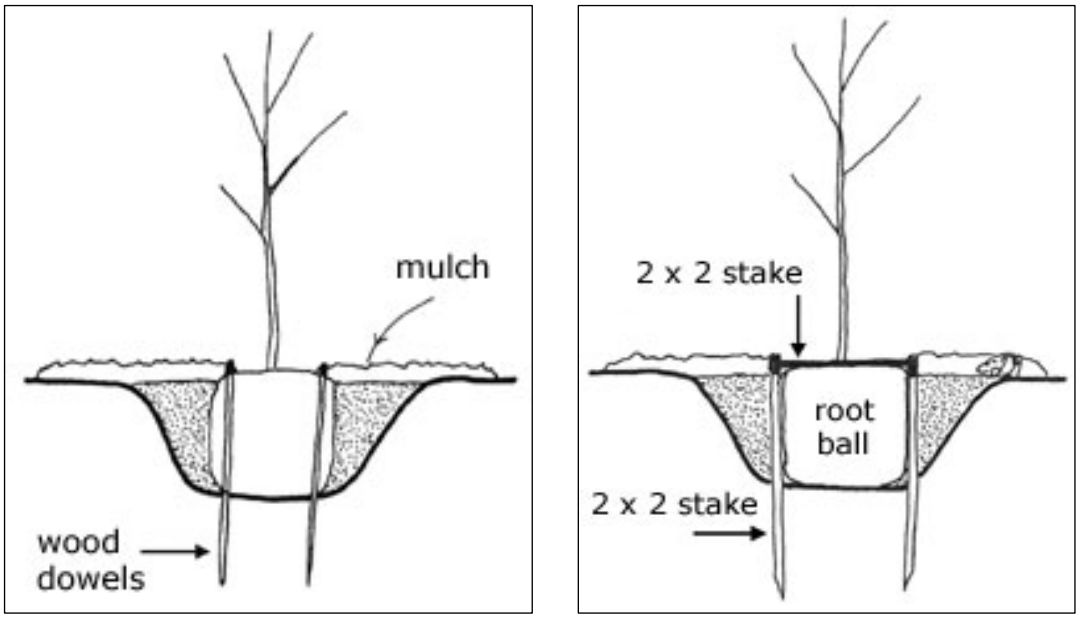


Figure 5.7 – Other Acceptable Staking Method

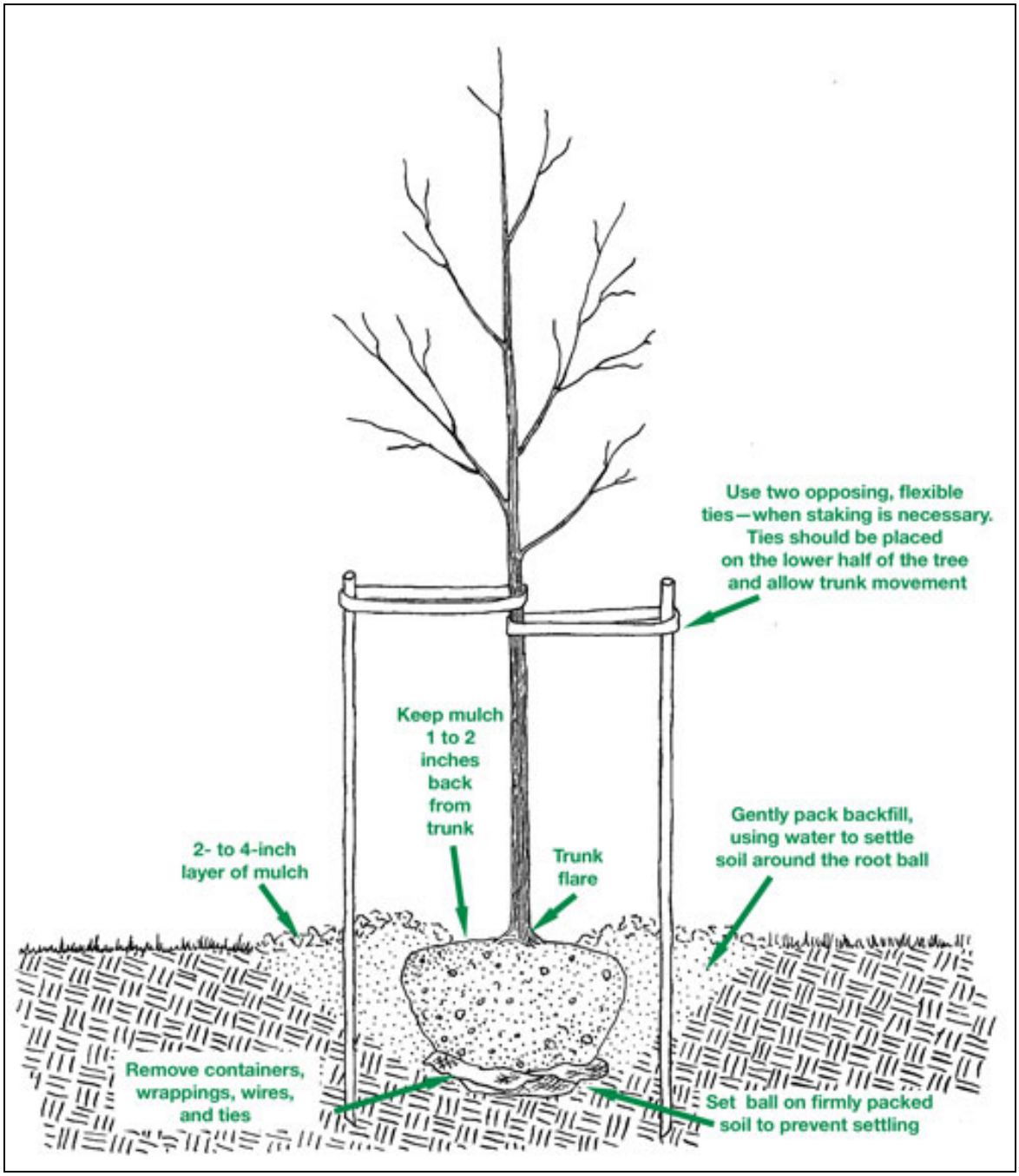


Figure 5.8 – Street Tree Planting Options

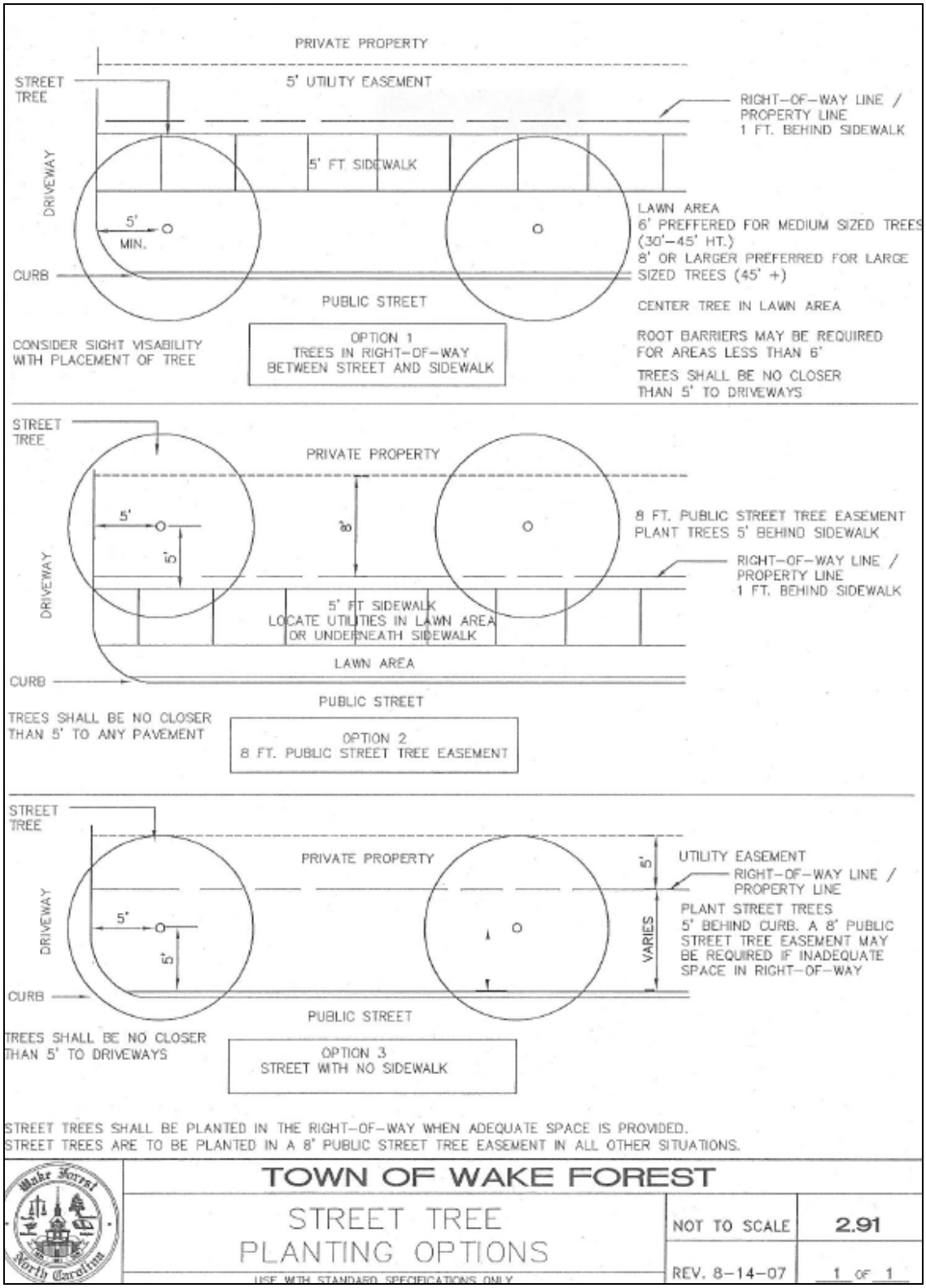
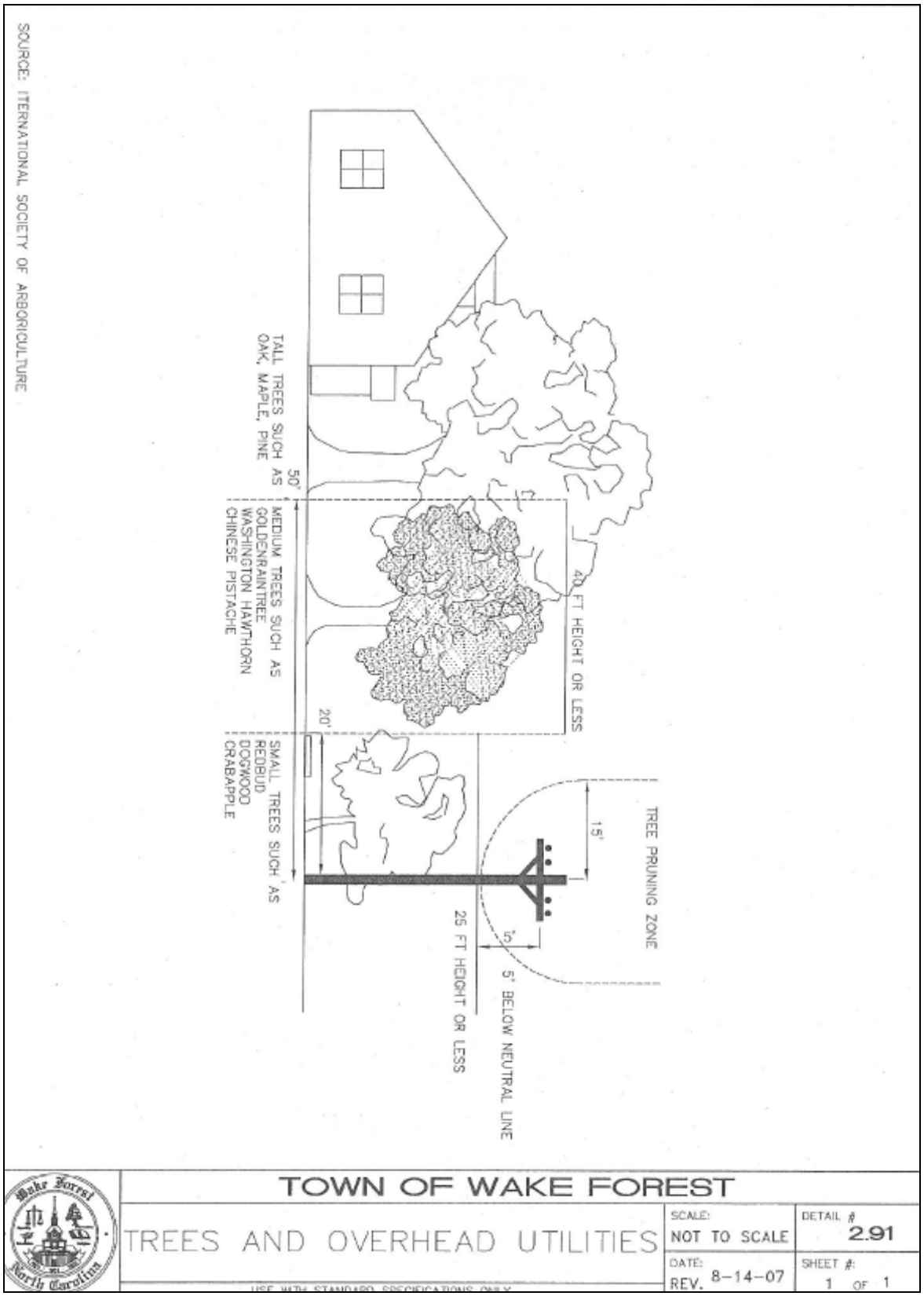


Figure 5.9 – Trees and Overhead Utilities



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6 APPLICATION CECKLISTS

(last revised 7/1/14)

6.1 INTRODUCTION

The following section has been provided to assist developers and engineers with the preparation of the various applications required by the Town of Wake Forest. Submittal requirements and checklists can be found on each application provided on the Town of Wake Forest's website. The submittal requirements are set by the Administrator and may be amended from time to time.

6.2 DEVELOPMENT PERMIT

6.2.1 GENERAL SUBMITTAL REQUIREMENTS

Each application for a Development Permit shall be accompanied by a plan in duplicate, drawn to scale, one copy of which shall be returned to the owner upon approval. If the property to be developed requires the use of a septic tank, the plan shall be accompanied by a letter of approval from the Wake County Health Department. The plan shall include:

A. The shape and dimensions of the lot on which the proposed building or use is to be constructed or conducted;

B. The location of the said lot with respect to adjacent rights-of-way & easements;

C. The shape, dimensions, and location of all buildings, existing and proposed, on the said lot;

D. The nature of the proposed use of the building or land, including the extent and location of the use, on the said lot;

E. The location and dimensions of off-street parking and loading space and the means of ingress and egress to such space, and

F. Any other information which the Administrator may deem necessary for consideration in enforcing the provisions of this ordinance.

G. If any portion of a lot is in a Special Flood Hazard Area, the application for a development permit shall also include plans drawn to scale showing the nature, location, dimensions, and elevations of the area in question. If an encroachment of the Special Flood Hazard Area is proposed, a Floodplain Development Permit, in accordance with Section 15.7.3 of the UDO, is required as well.

H. Plan Review Applications and other Planning forms are available online at:
http://www.wakeforestnc.gov/forms-applications.aspx
http://www.wakeforestnc.gov/planning.aspx

6.2.2 SIGNAGE PLAN

When a Development Permit is required by the UDO for erecting, placing, rebuilding, reconstructing or moving any sign, a Signage Plan shall be submitted with the following plan or plans drawn to scale:

A. The dimensions of the sign.

B. The dimensions of the sign supporting members.

C. The maximum and minimum height of the sign.

D. The proposed location of the sign in relation to the building and/or physical surroundings.

E. The Underwriters' Laboratory label number shall be required prior to erecting any electrical sign.

6.3 TREE CLEARING PERMIT

Developers are to comply with the Tree Protection ordinance as described in the Town's Unified Development Ordinance (UDO), Section 8 and Section 15.7.1.

6.3.1 SUBMITTAL REQUIREMENTS

An application for a Tree Clearing Permit may be filed only by the owner(s) of the property in question or an authorized agent thereof. An application for a Tree Clearing Permit shall be filed with the Administrator and shall be accompanied by a Vegetation Protection Plan that shall include, at a minimum, the following information on a sheet size no larger than 24 by 36 inches at a minimum scale of one inch equals 50 feet:

A. Vicinity map showing the location of the tract at a readable scale;

B. A map of the entire tract, including the property boundary of the entire tract by courses and distances with references to true meridian and the location and dimension of all on-site and adjacent off-site easements (e.g., drainage, utility, public access, aerial utility, conservation, permanent and temporary construction easements);

C. General information about the tract, including but not limited to the owner of the tract; the current zoning of the tract, the area of the tract, and the conditional-use zoning conditions, planned unit development master plan requirements, if applicable;

D. The location and use(s) of all existing building(s) on the tract;

E. The owner, current zoning and present use of all contiguous properties (including property on opposite side of adjoining streets);

F. The general classification of all existing and proposed adjacent roadways and the ultimate right-of-way boundaries associated with these roadways;

G. The location and width of all future/existing buffers and associated vegetation protection areas, including riparian buffers, perimeter buffers and perimeter streetyards;

H. The proposed limits of timbering activities, including the location and extent of all tree protection fencing as required by this section;

I. The Administrator may reduce or waive the requirements for a Vegetation Protection Plan in situations where it can be demonstrated that all vegetation removal will take place outside of required vegetation protection areas.

6.4 LAND DISTURBANCE PERMIT

Detailed requirements for erosion and sedimentation control may be found in Section 4 of Appendix B and online at:

http://www.wakeforestnc.gov/residents-engineering_erosionandsedimentcontrol.aspx

Required Erosion and Sedimentation Control Plans must contain at least all of the items specified on the Town of Wake Forest Erosion and Sedimentation Control Checklist, including administrative fees, pin number, bonds, a copy of deed/land owner approval, engineering drawings, maps, bonding, basin drainage area, existing soils, one set of calculations showing MUSLE (modified universal soil loss

equation), 401/404 signed permits if required, NCDOT Driveway permits, NCDOT easements, property easements/access, and narrative statements as needed to adequately describe the proposed development of the tract and the measures planned to comply with the erosion and sedimentation control regulations of this article. Plan content may vary to meet the needs of specific site requirements. Detailed guidelines for plan preparation may be obtained from the Town of Wake Forest Engineering Department upon request.

6.4.1 SUBMITTAL REQUIREMENTS

Required Information	Completed
Fees – Due prior to 1st review.	
Financial Responsibility Ownership Form	
E&SC Calculations (1 copy)	
Stormwater Calculations (1 copy)	
Stormwater Maintenance and Operation Agreement (due upon completion)	
NCDOT Encroachment/Driveway Permit	
DWR 401 Permit	
USACOE 404 Permit	
All Plans for Review (see below for minimum requirements)	
Location/Vicinity Map	
Existing and Proposed Contours (including offsite)	
Phased Grading Plan (minimum phases to include “initial,” “midway,” and “final”)	
Boundaries of Land Disturbance (clearly delineated with calculated acreage)	
Soils Area Map	
Drainage Area Delineation Map (existing site and final site)	
Existing Storm Utilities Map (including all utility easements, storm drainage, basins and level spreaders)	
Properties Map (including existing lot lines, lot numbers and surrounding property owners)	
Hydrology Map (including stream centerlines, stream buffers, wetlands and floodplains)	
Temporary Erosion Control Plan	
1. Erosion Control Measure Calculations (including sediment basins, sediment traps, skimmers, ditches, etc.) – must use Revised Universal Soil Loss Equation* and/or Modified Universal Soil Loss Equation** for entire site	
2. Skimmer Basins (required for drainage areas over 5 acres)	
3. Construction Entrance (50 foot minimum)	
4. Silt Fences (metal posts with wire)	
5. Hardware Cloth Outlets (special sediment control fences)	
6. Tree Protection Fencing (with “Do not enter Tree Protection Area” signs in English and Spanish) – required around	

perimeter of property, at buffer zones, and in tree save areas (around the drip line)	
7. Diversion Ditches	
8. Inlet Protection	
9. Erosion Details per NCDEMLR Erosion and Sediment Control Planning and Design Manual, latest edition	
Permanent Erosion/Stormwater Control Plan	
1. Stormwater Calculations (including pre and post-development peak flow (Q) and percent impervious surface)	
2. Proposed Stormwater Easements (recorded)	
3. Maintenance and Operation Agreement	
4. As-Builts (including length and size of stormwater ponds/bio-cells, level spreaders, storm drainage inverts, tops, grates, slopes, etc.)	
5. Permanent Ditches with Matting	
6. Stormwater Details per NC Division of Water Resources Stormwater Best Management Practices Manual, latest edition	
7. Stabilization Timeframe Chart	

***Revised Universal Soil Loss Equation (RUSLE)**

RUSLE: A = R*K*LS*C*P

Where : A = Longtime average annual soil loss

R = Rainfall runoff factor

K = Soil Erodability Factor

LS = Topographic Factor, where L represents the length and S represents the slope steepness

C = Cover management factor

P = Support practice

****Modified Universal Soil Loss Equation (MUSLE)**

MUSLE: T = 95*(V*Qp)^0.56 *K*LS*C*P

Where T = Sediment yield, tons per storm event

V = volume of runoff, acre-feet

Qp = Peak flow, cfs

K, LS, C, & P are the same as above for RUSLE

6.5 FLOODPLAIN DEVELOPMENT PERMIT

Developers are to comply with the Town's Flood Damage Prevention requirements as described in the Unified Development Ordinance (UDO), Section 12.4 and Section 15.7.3. Additional information is available online at:

http://www.wakeforestnc.gov/forms-applications.aspx
http://www.wakeforestnc.gov/planning.aspx

6.5.1 SUBMITTAL REQUIREMENTS

Applications for a Floodplain Development Permit shall be made to the Administrator prior to any development activities located within Special Flood Hazard Areas and shall meet the requirements found in Chapter 15 of the UDO. In addition to a Flood Development Permit, a Letter of Map Revision through the applicable state or federal agency may be required. The following items shall be presented to the Administrator with the Floodplain Development Permit application:

A. A plan drawn to scale which shall include, but shall not be limited to, the following: specific details of the proposed floodplain development:

1. The nature, location, dimensions, and elevations of the area for development/disturbance; existing and proposed structures, utility systems, grading/pavement areas, fill materials, storage areas, drainage facilities, and other development;

2. The boundary of the Special Flood Hazard Area as delineated on the FIRM or other flood map as determined in Section 12.4 of the UDO or a statement that the entire lot is within the Special Flood Hazard Area;

3. Flood zone(s) designation of the proposed development area as determined on the FIRM or other flood map as determined in Section 12.4 of the UDO;

4. The boundary of the floodway(s) or non-encroachment area(s) as determined in Section 12.4 of the UDO;

5. The Base Flood Elevation (BFE) or Future Conditions Flood Elevation where provided as set forth in Section 12.4 of the UDO;

6. The old and new location of any watercourse that will be altered or relocated as a result of proposed development;

7. Certification of the plot plan by a registered land surveyor or professional engineer.

B. Proposed elevation and method thereof, of all development within a Special Flood Hazard Area including but not limited to:

1. Elevation in relation to mean sea level of the proposed reference level (including basement) of all structures;

2. Elevation in relation to mean sea level to which any non-residential structure in Zone AE, A or X (Future) will be flood-proofed; and

3. Elevation in relation to mean sea level to which any proposed utility systems will be elevated or floodproofed.

C. If floodproofing, a Floodproofing Certificate (FEMA Form 81-65) with supporting data and an operational plan that includes, but is not limited to, installation, exercise, and maintenance of floodproofing measures.

D. A Foundation Plan, drawn to scale, which shall include details of the proposed foundation system to ensure all provisions of this ordinance are met. These details include but are not limited to:

1. The proposed method of elevation, if applicable (i.e., fill, solid foundation perimeter wall, solid backfilled foundation, open foundation on columns/posts/piers/piles/shear walls);
2. Openings to facilitate equalization of hydrostatic flood forces on walls, in accordance with Section 12.4.2.B.3.d of the UDO, when solid foundation perimeter walls are used in Zones A, AE and X (future);
3. Usage details of any enclosed areas below the regulatory flood protection elevation.
4. Plans and/or details for the protection of public utilities and facilities such as sewer, gas, electrical, and water systems to be located and constructed to minimize flood damage;
5. Copies of all other Local, State and Federal permits required prior to floodplain development permit issuance (Wetlands, Endangered Species, Erosion and Sedimentation Control, Riparian Buffers, Mining, etc.)
6. Documentation for placement of Recreational Vehicles and/or Temporary Structures, when applicable, to ensure the provisions of Section 12.4.2.B.5 of the UDO are met.
7. A description of proposed watercourse alteration or relocation, when applicable, including an engineering report on the effects of the proposed project on the flood-carrying capacity of the watercourse and the effects to properties located both upstream and downstream; and a map (if not shown on plot plan) showing the location of the proposed watercourse alteration or relocation.

6.6 STORMWATER MANAGEMENT PERMIT

The purpose of this section is to establish the minimal plan submittal requirements for stormwater plan review and approval. Minimal plan submittal requirements for stormwater management permit is described in Section 2 of this Manual and online at:

http://www.wakeforestnc.gov/npdes-phase-ii.aspx

6.6.1 SUBMITTAL REQUIREMENTS

Two complete sets of site plan drawings and two complete sets of sitework calculations shall be submitted to the Town Engineering Department for review and approval, and shall include:

A. Certification Requirements

The following certifications shall appear on all plans.

1. Designer's Certification

"I hereby certify that, to the best of my ability, this plan has been prepared in accordance with the latest Town of Wake Forest Standards and Specifications for Stormwater Management and Stormwater Policy of the Town Code of the Town of Wake Forest."

Signature:_____
Printed Name and Title:_____
Date:_____Registration Number: _____

2. **Owner's/Developer's Certification**

"I/We hereby certify that all site construction, drainage and grading will be done pursuant to this plan and that the applicable Stormwater Management conditions and requirements of the Town of Wake Forest, the State of North Carolina and the Federal Government and its agencies are hereby made part of this plan."

Signature:_____
Printed Name:_____
Title:_____Date:_____

B. Stormwater Management Permit Application, Supplement Forms, and Checklists: The stormwater management permit application package shall include the Stormwater Permit Application, Checklist, Supplement Forms, calculations, etc. as discussed in Appendix B, Section 2 Stormwater Management and found in Section 2.12, Stormwater Appendix.

C. Additional Requirements: Approval of Stormwater Management Plans and Calculations by the Town of Wake Forest Engineering Department does not complete the Town of Wake Forest review process. All other applicable Town Departments, County, State, and Federal agencies must also approve the plan as warranted. It shall be the sole responsibility of the Owner/Developer/Designer to acquire all applicable approvals.

CHECKLIST FOR STORMWATER STANDARDS

Town of Wake Forest

OFFICE USE ONLY:
File Number:_____
Number of Plan Sets Received:_____
Date of Submittal:_____
Reviewer's Name:_____

Please provide complete documentation and details where applicable. NO PLAN SUBMITTAL will be complete unless all information is filled out completely. Indicate ***"Not Applicable"*** where appropriate.

Name of Development:_____

Owner Information:
Name: _____
Address:_____
_____
Voice Number:_____Fax Number: _____
E-mail address:_____

Developer Information:
Name: _____
Address:_____
_____
Voice Number:_____Fax Number: _____
E-mail address:_____

Designer Information:
Name of Company:_____
Address:_____
_____
Project Designer:_____Registration Number:_____
Voice Number:_____Fax Number: _____
E-mail Address:_____

Plan Requirements (Indicate ***"N/A"*** where appropriate)**:**

Yes	No	N/A	Sheet No.	Description	Remarks
☐	☐	☐	_____	Development Name	_____
☐	☐	☐	_____	Owner	_____
☐	☐	☐	_____	Design Firm	_____
☐	☐	☐	_____	Sealed, Signed and Dated	_____
☐	☐	☐	_____	Sheet Number	_____
☐	☐	☐	_____	Date	_____
☐	☐	☐	_____	Revision Numbers and Dates	_____
☐	☐	☐	_____	Designer's Certification	_____
☐	☐	☐	_____	Owner's/Developer's Certification	_____
☐	☐	☐	_____	North Arrow	_____
☐	☐	☐	_____	Property Lines	_____
☐	☐	☐	_____	Legend	_____
☐	☐	☐	_____	Vicinity Map	_____
☐	☐	☐	_____	Scale	_____
☐	☐	☐	_____	Adjacent Property Owners	_____
☐	☐	☐	_____	Existing Streets, Buildings, etc.	_____
☐	☐	☐	_____	Wooded Limits	_____
☐	☐	☐	_____	Wetland Limits	_____
☐	☐	☐	_____	Easements	_____
☐	☐	☐	_____	Land Use of Surrounding Areas	_____
☐	☐	☐	_____	Original Contours (2-foot intervals)	_____
☐	☐	☐	_____	Actual Field Survey	_____
☐	☐	☐	_____	Town/USGS Topographical Data	_____
☐	☐	☐	_____	Existing Streams, Lakes, etc.	_____
☐	☐	☐	_____	Proposed Contours (2-foot intervals)	_____
☐	☐	☐	_____	Size and Location of Existing Culverts	_____
☐	☐	☐	_____	Size and Location of Proposed Culverts	_____
☐	☐	☐	_____	Submitting Two Set of Plans	_____

Calculation Requirements:

Yes	No	N/A	Sheet No.	Description	Remarks
☐	☐	☐	_____	Development Name	_____
☐	☐	☐	_____	Owner	_____
☐	☐	☐	_____	Design Firm	_____
☐	☐	☐	_____	Sealed, Signed and Dated	_____
☐	☐	☐	_____	Submitting Two Sets of Calculations	_____

Piped Systems:

☐	☐	☐	_____	Designed for 10-yr Storm	_____
☐	☐	☐	_____	Analyzed for 25-yr Storm	_____
☐	☐	☐	_____	Minimum Velocity = 2.5 FPS	_____
☐	☐	☐	_____	Minimum Cover = 2 Feet	_____
☐	☐	☐	_____	Headwall or Flared End Sections	_____
☐	☐	☐	_____	Energy Dissipater Calculations	_____
☐	☐	☐	_____	Evaluation of Downstream System	_____
☐	☐	☐	_____	Catch Basin Designed for 2-yr Storm	_____
☐	☐	☐	_____	Public Easement Terminates at the end of the Stilling Basin or Outlet Protection	_____
☐	☐	☐	_____	Private Easement Begins at the end of the Stilling Basin or Outlet Protection	_____

Open Channel Systems:

☐	☐	☐	_____	Designed for 10-yr Storm	_____
☐	☐	☐	_____	Analyzed for 25-yr Storm	_____
☐	☐	☐	_____	Side Slopes 3 to 1 or flatter	_____
☐	☐	☐	_____	Minimum Bottom Width = 3 Feet	_____
☐	☐	☐	_____	Velocity Check (Liners provided, If Needed)	_____
☐	☐	☐	_____	Evaluation of Downstream System	_____
☐	☐	☐	_____	Public Easement Ends and Private Easement Begins at the Beginning of the Ditch Section	_____

Other Plan Submittals:

☐	☐	☐	_____	Wake Forest Erosion Control	_____
☐	☐	☐	_____	NCDOT	_____
☐	☐	☐	_____	US Army Corps of Engineers	_____
☐	☐	☐	_____	NCDWR	_____

SUBMITTAL WORKSHEET FOR DRY DETENTION AND WET RETENTION FACILITIES

The Town of Wake Forest will follow the Division of Water Quality – 401 Wet Detention Basin Design for all detention and retention basins within the Town's jurisdiction. Please provide complete documentation and details where applicable. A complete stormwater management plan submittal includes a detention/retention basin worksheet for each basin, design calculations, plan and specifications showing all basin and outlet structure details, and a fully executed operation and maintenance agreement. An incomplete submittal package will result in a request for additional information and will substantially delay final review and approval of the project. Indicate "Not Applicable" where appropriate if design is a dry detention basin.

I. Project Information (please complete the following information):

Project Name: _____

For projects with multiple basins, specify which basin this worksheet applies to:_____

Basin Bottom Elevation	_____	ft.	(average elevation of the floor of the basin)
Permanent Pool Elevation	_____	ft.	(elevation of the orifice invert out)
Temporary Pool Elevation	_____	ft.	(elevation of the outlet structure invert in)
Permanent Pool Surface Area	_____	sq. ft.	(water surface area at permanent pool elevation)
Drainage Area	_____	ac.	(on-site and off-site drainage to the basin)
Impervious Area	_____	ac.	(on-site and off-site drainage to the basin)
Permanent Pool Volume	_____	cu. ft.	(combined volume of main basin and forebay)
Temporary Pool Volume	_____	cu. ft.	(volume detained on top of the permanent pool)
Forebay Volume	_____	cu. ft.	
SA/DA used	_____		(surface area to drainage area ratio)
Diameter of Orifice and Number	_____/_____	in.	(draw down orifice diameter and number of)

II. Required Items Checklist

The following checklist outlines design requirements per the Stormwater Best Management Practices Manual (N.C. Department of Environment, Health and Natural Resources, November 1995) and Administrative Code Section: 15 A NCAC 2H .1008. Initial in the space provided to indicate the following design requirements have been met and supporting documentation is attached. *If a requirement has not been met, attach an explanation of why.*

Applicants Initials	
_____	The temporary pool controls runoff from the 1 inch storm event
_____	The basin length to width ratio is greater than 3:1
_____	The basin side slopes are no steeper than 3:1
_____	A submerged and vegetated perimeter shelf at less than 6:1 is provided
_____	Vegetation to the permanent pool elevation is specified
_____	An emergency drain is provided to drain the basin
_____	The permanent pool depth is between 3 and 6 feet (required minimum of 3 feet)
_____	The temporary pool draws down in 2 to 5 days
_____	The forebay volume is approximately equal to 20% of the total basin volume
_____	Sediment storage is provided in the permanent pool
_____	Access is provided for maintenance
_____	A minimum 30-foot vegetated filter is provided at the outlet
_____	A site specific operation and maintenance (O&M) plan is provided
_____	A vegetation management/mowing schedule is provided in the O&M plan
_____	Semi-annual inspections are specified in the O&M plan
_____	A debris check is specified in the O&M plan to be performed after every storm event
_____	A specific sediment clean-out benchmark is listed (elevation or depth) in the O&M plan
_____	A responsible party is designated in the O&M plan

6.7 SITE PLAN APPLICATIONS

6.7.1 SITE MASTER PLAN

The Site Master Plan is intended to provide a detailed two-dimensional drawing that illustrates all of the required site features including the following information:

A. Existing Conditions Information

1. Existing developed conditions of the property including:
   - **a.** Existing structures with built year & historical significance;
   - **b.** Cemeteries;
   - **c.** Bridges or culverts;
   - **d.** Utilities (water & sewer, drainage, storm water, electrical, cable, fiber optics, etc.);
   - **e.** Driveways & curb cuts;
   - **f.** Sidewalks, surface parking & loading areas;
   - **g.** Public and private streets with pavement width;
   - **h.** Any known contaminated soils or hazardous materials;
   - **i.** Existing & proposed easements including but not limited to, electric, water, sewer, storm, drainage, private streets, gas, or other service related easements including location, width & purpose.
2. Existing natural features of the property including:
   - **a.** Forest stands or trees of a uniform size and species;
   - **b.** Specimen trees of varying sizes and species, particularly free standing or open-grown or field grown trees;
   - **c.** Previously documented rare or protected species' habitats.
   - **d.** Riparian & watershed boundaries/buffers, wetlands, watercourses with name and direction of flow;
   - **e.** State & federal reports regarding wetlands and stream buffer delineations;
   - **f.** Special flood hazard areas;
   - **g.** Wood line & vegetation type with location of all specimen trees;
   - **h.** Soils map;
   - **i.** Existing contour lines at a minimum of two (2) foot contour intervals.

B. General Information

1. Vicinity Map of area showing location of property & existing surrounding site conditions at a scale of not less than 1 inch = 1,000 feet;
2. North arrow on all sheets;
3. Boundaries of the proposed property to be developed;
4. Owner & developers contact information;
5. Layout standards, certificates & details from Section 6.11 of the MSSD.
6. Five paper copies of plans at a scale not less than 1 inch = 50 feet.

7. Administrative fees.

C. Site & Structure Information

1. Site data information (e.g., zoning, land use, wake county tax pin number, setbacks, acreage).
2. Development calculations (e.g., density, lot dimensions, proposed building areas, number & size of structure(s), number of parking spaces, estimated impervious surface area calculations) in sufficient detail to show compliance with the Wake Forest UDO.
3. Buildings, parking areas & driveways on site & adjacent properties;
4. Street and/or right-of-way locations with street sections;
5. Location of sidewalks, pedestrian ways & open space areas;
6. Property lines & setback lines.
7. Watercourse, land use & screening buffer areas.
8. Site landscaping plan (in conceptual form only).
9. Lighting plan (in conceptual form only);
10. Location of all Special Flood Hazard Areas (if applicable).
11. Conceptual location of subsurface utilities. Detailed engineering drawings such as (e.g. water & sewer) & on-site stormwater facilities are not required for Master Plans, except that horizontal water & sewer locations shall be required by the City of Raleigh Public Utilities Department.

6.7.2 SITE CONSTRUCTION PLAN

A Construction Plan is intended to provide a full & complete set of engineered drawings necessary for final permitting & construction that illustrates all of the required site features including the following information:

A. Existing Conditions Information: See 6.7.1.A above for required information.

B. General Information

1. Vicinity Map of area showing location of property & existing surrounding site conditions at a scale of not less than 1 inch = 1,000 feet;
2. North arrow on all sheets;
3. Boundaries of the proposed property to be developed;
4. Owner & developers contact information;
5. Layout standards, certificates & details from Section 6.12 of the MSSD.
6. Five paper copies of plans at a scale not less than 1 inch = 50 feet.
7. Administrative fees.

C. Site & Structure Information

1. Site data table & illustration of:
   a. Zoning & zoning case number;
   b. Proposed land use
   c. Wake county tax pin number

d. Setbacks,

e. Acreage.

f. Watershed & watercourse areas.

2. Development Calculations & Illustration of:

a. Density

b. Lot dimensions

c. Proposed number of buildings their height & size of structure(s),

d. Number of parking spaces required & proposed,

e. Impervious surface area calculations (if applicable)

3. Buildings, parking areas & driveways on site & adjacent properties;

4. Location of sidewalks, pedestrian ways & open space areas;

5. Location & method of garbage containment & disposal;

6. Property lines & setback lines.

7. Location and height of all retaining walls;

8. Watercourse, land use & screening buffer areas.

9. Site landscaping plan (see 6.8 & Chapter 8 of UDO for details).

10. Lighting plan (see Chapter 10 for details).

11. Location & dimensions of all easements on & abutting the property.

12. Location of all Special Flood Hazard Areas (if applicable).

D. Streets & Traffic Control

1. Linear footage of all public streets.

2. Street and/or right-of-way locations with street sections;

3. Provisions & design of all on & off site roadway improvements.

4. All traffic control signage & it's conformance to the MSSD.

5. Plan-profile drawings at a scale of 1 inch = 50 feet showing street grades & cross sections.

E. Utilities

1. Detailed stormwater, grading & erosion control information per the MSSD.

2. Detailed water & sewer information per City of Raleigh Public Utilities.

3. Linear footage of all storm drainage facilities;

4. Tree Save Areas & protection measures.

F. Landscape Plan: When a Site Construction Plan review is required by the UDO, the Construction Plan shall include a detailed Landscape Plan with the following elements:

1. Existing vegetation and landscaping including the location, condition, and diameter at breast height (DBH) of all specimen trees that are 20" DBH and greater and all native flowering trees 8" DBH and greater including their critical root zones; and, any designated Historic or landmark trees;

2. Locations of new planting material with a plant list that includes common and botanical plant names, baseline requirement (canopy or understory), quantity, caliper, height and spacing;
3. Locations and dimensions of planting areas, parking lot islands, streetyards and bufferyards, areas of reforestation, and the location and dimensions of walls, berms, and fencing;
4. The delineation of existing vegetation which is to be maintained or preserved as a Tree Save Area ("TSA") to meet or supplement the requirements of this section including their critical root zones;
5. Locations of waterbodies and required watercourse buffers, overhead and underground utilities, easements, sight triangles, and the limits of land disturbance, clearing, grading, and trenching:
6. All applicable details, specifications, procedures and schedules for new tree and shrub installation, transplanting, tree wells, tree staking, etc.;
7. The location and description of all tree protection measures which are to be utilized;
8. The planting schedule which is to be followed for the installation of all new plant material;
9. All notes and certificates required for any Tree Clearing activity.

G. **Landscape Maintenance Plan:** The following statement shall be placed on the landscape sheet prior to plan approval. This statement must be individualized based on each site and/or subdivision plan. This should be done by a certified landscape architect.

"The owners of the property and their agents, heirs, or assigns shall be responsible for the installation, preservation, and maintenance of all planting and physical features shown on this plan. Failure to maintain all plantings in accordance with this plan may constitute a violation of this Ordinance and may result in fines. The owners shall be responsible for maintenance of the vegetation, including but not limited to:

1. *Fertilization (optional).*
2. *Pruning within limits (applicant must define limits).*
3. *Pest control.*
4. *Mulching.*
5. *Mowing (if any).*
6. *Protection of the root zones from equipment, construction and related materials, etc.*
7. *Method of irrigation.*
8. *Other continuing maintenance operations."*

6.7.3 FINAL PLAT

See Section 6.9.1 below

6.8 ARCHITECTURAL DESIGN REVIEW

6.8.1 SUBMITTAL REQUIREMENTS

All applications for Architectural Design Review must submit a Sketch Plan and Building Elevations for Design Review to the Administrator and the Design Review Board (if applicable) in accordance with Chapter 15 of the UDO. Building Design Standards for specific Urban Districts and requirements for specific Building Types (Civic/Institutional, Residential, Commercial, & Industrial) can be found in Chapter 5 of the UDO. In addition to these requirements, the submitted application should include the following:

A. General

1. A location map with north arrow, dimensions of site boundaries, acreage, information about ownership and uses, and existing or potential uses of adjacent property;
2. Scaled drawings of the floor plans. Include square footage figures for each floor. Show all proposed door and window locations;
3. One 24" x 36" rendered elevations of each façade indicating heights, floor levels, and materials;
4. Illustrative perspective renderings of the proposed building(s), including at least one eye-level view from a public right-of-way and one view illustrating the character of any adjacent buildings in context;
5. One 18" x 24" color rendering of each façade is required. Rendered elevations should describe location and use of each color and material. Building materials/colors for roof roofing, siding, doors, windows, etc.
6. Administrative fee.

B. Overall Requirements: The application should provide evidence that clearly illustrates the following requirements have been met in the design of the building(s).

1. Varied roof line;
2. Unify individual storefronts in one building while varying the look and providing distinctiveness from storefront to storefront;
3. Facades greater than 100 feet interrupted by recesses, projections, windows, awning, arcades, color, texture, and/or material. All facades visible from the street or adjoining properties feature characteristics similar to the front;
4. Customer entrances featuring one or more – canopies, porticos, arcades, arches, wing walls, and planters;
5. High quality exterior building materials, e.g. brick, stucco, wood, stone tinted/textured decorative concrete masonry units, or similar materials;
6. Colors harmonious with surrounding development and that reflect the traditional concept of the town. Colors should be earth tone, muted, subtle, or neutral colors;
7. Trash containment devices located and/or screened so as not to be visible from streets or other properties. Screening of trash containment areas should match colors and materials used on building;
8. Mechanical and utility equipment located and/or screened so as not to be visible from streets or other properties, including equipment located on the roof.

6.9 SUBDIVSION APPLICATIONS

The purpose of this section is to provide a guide for the preparation of applications for Minor and Major Subdivisions in accordance with Chapter 15 of the UDO.

6.9.1 MINOR SUBDIVISIONS & FINAL PLAT

The following information shall be required in all applications for Minor Subdivisions and Final Plats.

A. Zoning of Tract: Zoning classification on the land to be subdivided and on adjoining land.

B. Boundary: The exact boundary lines of the tract(s) to be subdivided (fully dimensioned by lengths and bearings) and the location of intersecting boundary lines of adjoining lands, with adjacent subdivisions identified by official maps. The square footage and acreage of the resultant lots shall also be included.

C. Monument and Control Corners: The accurate locations and descriptions of all monuments, markers, and control points.

D. Survey Data: Sufficient data to determine readily and reproduce on the ground every straight or curved boundary line, street line, lot line, right-of-way, easement line, and setback line, including dimensions, bearings, or deflection angles, radii, arcs, chords, central angles, and tangent distances for the center line of curved streets and curved property lines that are not the boundary of curved streets. All dimensions shall be measured to the nearest one-hundredth (1/100th) of a foot and all angles to the nearest one-half (½) minute.

E. Elevation Flood Data: Base flood elevation data shall be provided for subdivision proposals greater than fifty (50) lots or five (5) acres, whichever is less.

F. Streets: The widths, and names where appropriate, of all proposed streets and alleys, and of all adjacent streets and alleys, and easements which shall be properly located.

G. Easements: The location of all rights-of-way, easements, and areas to be dedicated to public use with the purpose of each stated.

H. Names and Vicinity Map: The name of the owner, and the surveyor, landscape architect, engineer, and their respective addresses and telephone numbers. Also, the name of the subdivision and a sketch vicinity map showing relationship between subdivision and surrounding areas at a legible scale. The vicinity map should be drawn to a scale of 1" = 800' and a north arrow shown.

I. Building Setback Lines: Minimum building setback lines.

J. Block and Lot Numbers. The blocks numbered consecutively throughout the entire subdivision and the lots numbered consecutively throughout each block.

K. Deed Restrictions on the Property: A statement indicating whether deed restrictions exist, the subject, and location.

L. Date: Date of the survey and plat preparation, a north arrow indicating whether true or magnetic, and graphic scale.

M. Administrative Fees: The appropriate filing fees, as determined by the Board of Commissioners, shall be paid to the Town of Wake Forest, North Carolina for each submittal of an administrative final plat.

N. Required Certificates/Approvals: The certificates and approvals listed below signed, stamped and dated appropriately.

Certificate of Ownership and Dedication
I hereby certify that I am the owner of the property shown and described hereon, which is located in the subdivision jurisdiction of Wake Forest, and that I hereby adopt this plan with my free consent, establish minimum building setback lines, and dedicate all streets, alleys, walks, parks, and other sites and easements to public or private use as noted.

_____
Date Owner(s)

Certificate of Survey and Accuracy
I _____, certify that this plat was drawn under my supervision from (an actual survey made under my supervision) (Deed description recorded in Book _____, Page ____, etc.); (other); that the boundaries not surveyed are shown as broken lines plotted from information found in Book ____, Page ; that this plat was prepared in accordance with G.S. 47_30 as amended. Witness my original signature, registration number and seal this the____day of _____A.D., 20 ___.

_____(Surveyor)

_____ (SEAL OR STAMP)
Registration Number

Approval from Wake County Health Department
If septic tanks are to be installed, a letter from the Wake County Health Department will be required indicating their approval of the subdivision.

_____ _____
Date Approving Authority

Approved for Recording by the Town of Wake Forest
State of North Carolina – County of Wake
I, _____, Review Officer of the Town of Wake Forest, certify that the map or plat to which this certification is affixed meets all statutory requirements for recording.

_____ _____
Date Town Clerk

6.9.2 MAJOR SUBDIVISION – MASTER PLAN

The Subdivision Master Plan is intended to provide a detailed two-dimensional drawing that illustrates all of the required site features including the following information:

A. Existing Conditions Information: See 6.7.1.A above for required information.

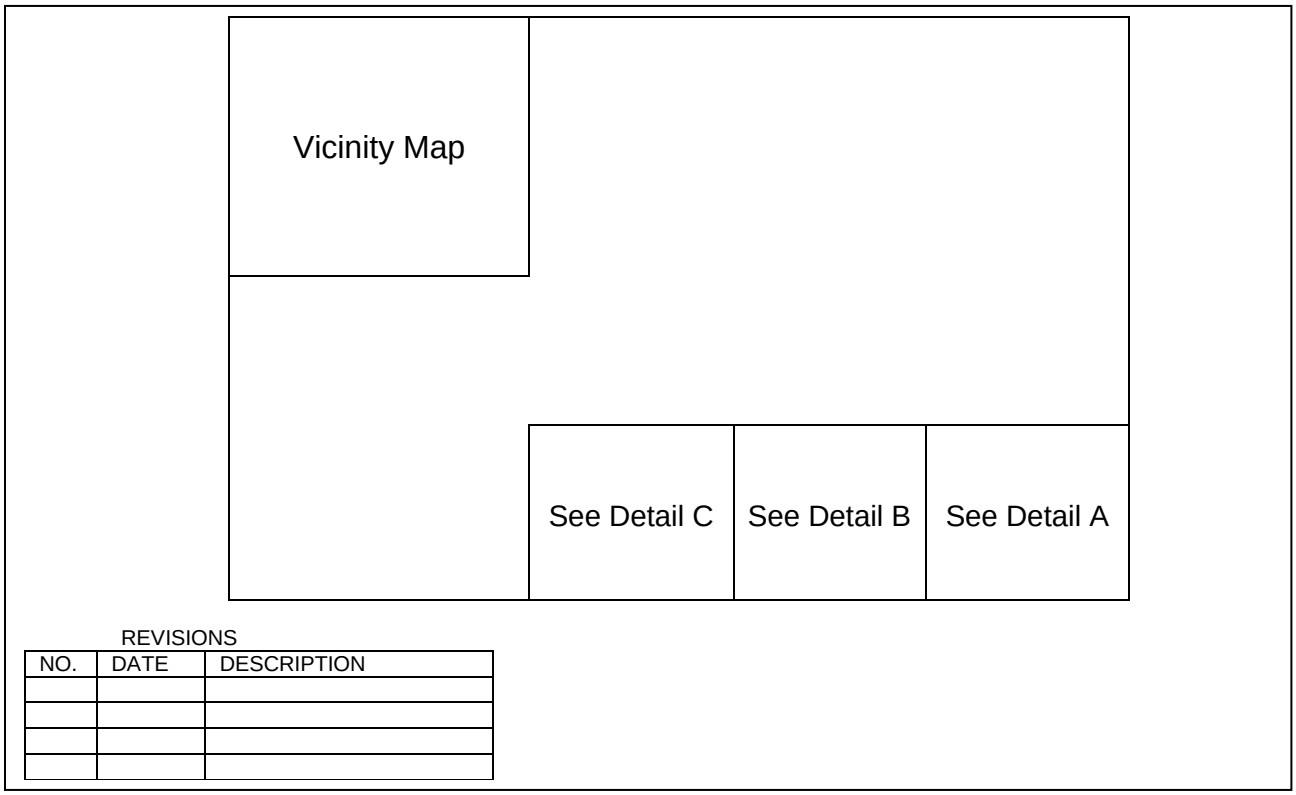
B. General Information

1. Vicinity Map of area showing location of property & existing surrounding site conditions at a scale of not less than 1 inch = 1,000 feet;
2. North arrow on all sheets;
3. Boundaries of the proposed property to be developed;
4. Proposed name of subdivision which shall not have the same spelling as or be pronounced similar to the name of any other subdivision located within the Town's jurisdiction.
5. Owner & developers contact information;
6. Layout standards, certificates & details from Section 6.11 of the MSSD.
7. Five paper copies of plans at a scale not less than 1 inch = 50 feet.
8. Administrative fees.

C. Site Information

1. Site data information (e.g., zoning, land use, wake county tax pin number, setbacks, acreage).
2. Development calculations (e.g., density, lot dimensions, estimated impervious surface area calculations) in sufficient detail to show compliance with the Wake Forest UDO.
3. Street and right-of-way locations with street sections;
4. Location of sidewalks & pedestrian ways.
5. Proposed plans & illustration of parks & open space areas per Chapter 7 & means of ownership & maintenance.
6. Property lines & setback lines.
7. Watercourse, land use & screening buffer areas.
8. Site landscaping plan (in conceptual form only).
9. Lighting plan (in conceptual form only);
10. Location of all Special Flood Hazard Areas (if applicable).
11. Conceptual location of subsurface utilities. Detailed engineering drawings such as (e.g. water & sewer) & on-site stormwater facilities are not required for Master Plans, except that horizontal water & sewer locations shall be required by the City of Raleigh Public Utilities Department.

D. Standard Master Plan Layout



E. Detail A: Standard Title Block

(NAME) SUBDIVISION PHASE (NO.) (REVISION NO.) **Wake Forest, N.C.**		
Owner(s)		
Address		
Phone		
E-mail Address		
NAME OF CONSULTING ENGINEERS	SURVEYED:	APPROVED:
	DRAWN:	DATE:
	CHECKED:	SCALE:

F. Detail B: Planning Board Approval Date

RECOMMENDATION FOR APPROVAL BY THE WAKE FOREST PLANNING BOARD **DATE** _____

G. Detail B: Board of Commissioners Approval Date

APPROVAL BY THE WAKE FOREST BOARD OF COMMISSIONERS **DATE** _____

6.9.3 MAJOR SUBDIVISIONS – CONSTRUCTION PLAN

The Subdivision Construction Plan is intended to provide a full & complete set of engineered drawings necessary for final permitting & construction that illustrates all of the required site features including the following information:

A. Existing Conditions Information: See 6.7.1.A above for required information.

B. General Information:

1. Vicinity Map of area showing location of property & existing surrounding site conditions at a scale of not less than 1 inch = 1,000 feet;
2. North arrow on all sheets;
3. Boundaries of the proposed property to be developed;
4. Proposed name of subdivision which shall not have the same spelling as or be pronounced similar to the name of any other subdivision located within the Town's jurisdiction.
5. Owner & developers contact information;
6. Five paper copies of plans at a scale not less than 1 inch = 50 feet.
7. Layout standards, certificates & details from Section 6.12 of the MSSD.

8. Administrative fees.

C. Site Information:

1. Site data table & illustration of:
   - **a.** Zoning & zoning case number;
   - **b.** Proposed land use
   - **c.** Wake county tax pin number
   - **d.** Setbacks,
   - **e.** Acreage.
   - **f.** Watershed & watercourse areas.
2. Development calculations & illustration of:
   - **a.** Density
   - **b.** Proposed lot lines, size & dimensions
   - **c.** Impervious surface area calculations (if applicable)
3. Location of sidewalks & pedestrian ways.
4. Proposed plans & illustration of parks & open space areas per Chapter 7 & means of ownership & maintenance.
5. Property lines & setback lines.
6. Location and height of all retaining walls;
7. Watercourse, land use & screening buffer areas.
8. Landscaping & Street Tree plan (see 6.8 & Chapter 8 of UDO for details).
9. Lighting plan (see Chapter 10 for details).
10. Location & dimensions of all easements on & abutting the property.
11. Location of all Special Flood Hazard Areas (if applicable).

D. Streets & Traffic Control

1. Linear footage of all public streets.
2. Street and/or right-of-way locations with street sections;
3. Provisions & design of all on & off site roadway improvements.
4. All traffic control signage & it's conformance to the MSSD.
5. Plan-profile drawings at a scale of 1 inch = 50 feet showing street grades & cross sections.

E. Utilities

1. Detailed stormwater, grading & erosion control information per the MSSD.
2. Detailed water & sewer information per City of Raleigh Public Utilities.
3. Linear footage of all storm drainage facilities;
4. Tree Save Areas & protection measures.

F. Landscape Plan: When a Major Subdivision Construction Plan review is required by the UDO, the Construction Plan shall include a detailed Landscape Plan with the following elements:

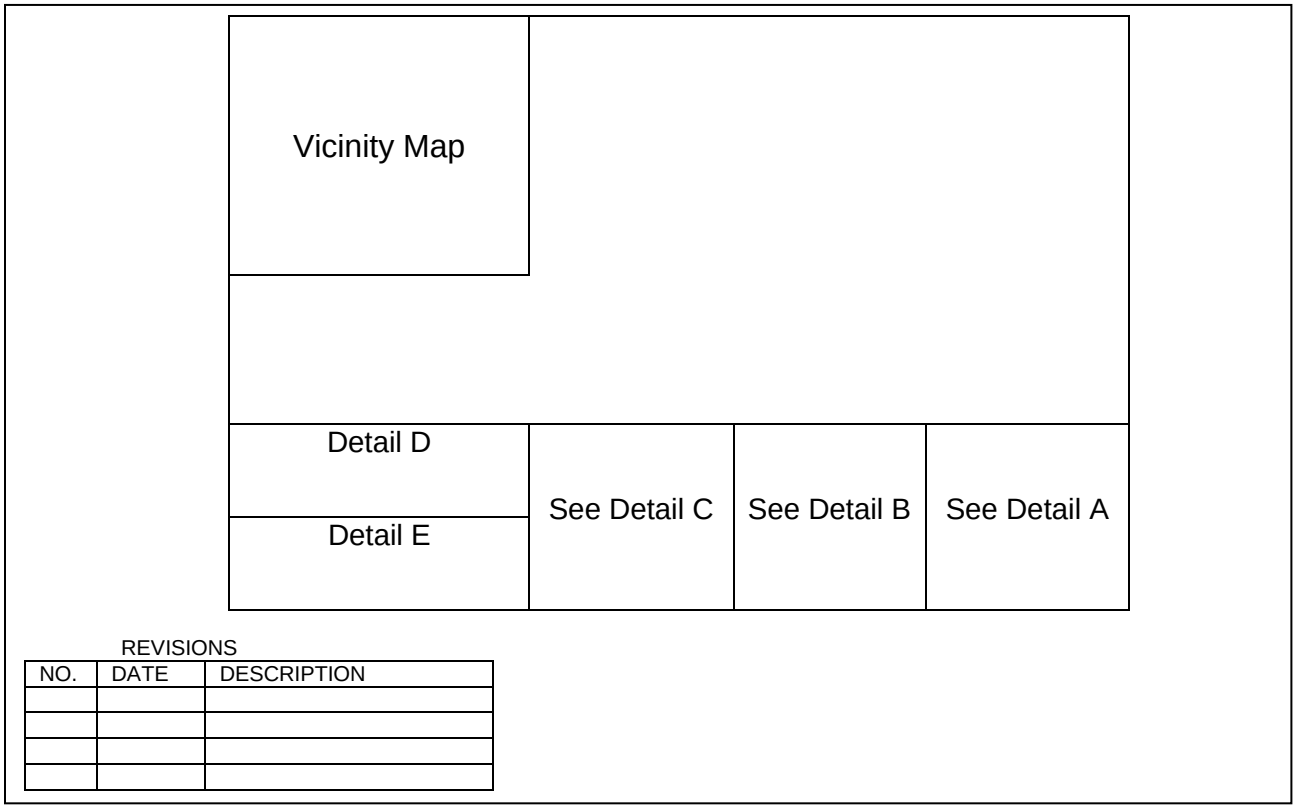
1. Existing vegetation and landscaping including the location, condition, and diameter at breast height (DBH) of all specimen trees that are 20" DBH and greater and all native flowering trees 8" DBH and greater including their critical root zones; and, any designated Historic or landmark trees;
2. Locations of new planting material with a plant list that includes common and botanical plant names, baseline requirement (canopy or understory), quantity, caliper, height and spacing;
3. Locations and dimensions of planting areas, parking lot islands, streetyards and bufferyards, areas of reforestation, and the location and dimensions of walls, berms, and fencing;
4. The delineation of existing vegetation which is to be maintained or preserved as a Tree Save Area ("TSA") to meet or supplement the requirements of this section including their critical root zones;
5. Locations of waterbodies and required watercourse buffers, overhead and underground utilities, easements, sight triangles, and the limits of land disturbance, clearing, grading, and trenching:
6. All applicable details, specifications, procedures and schedules for new tree and shrub installation, transplanting, tree wells, tree staking, etc.;
7. The location and description of all tree protection measures which are to be utilized;
8. The planting schedule which is to be followed for the installation of all new plant material;
9. All notes and certificates required for any Tree Clearing activity.

G. Landscape Maintenance Plan: The following statement shall be placed on the landscape sheet prior to plan approval. This statement must be individualized based on each site and/or subdivision plan. This should be done by a certified landscape architect.

"The owners of the property and their agents, heirs, or assigns shall be responsible for the installation, preservation, and maintenance of all planting and physical features shown on this plan. Failure to maintain all plantings in accordance with this plan may constitute a violation of this Ordinance and may result in fines. The owners shall be responsible for maintenance of the vegetation, including but not limited to:

1. *Fertilization (optional).*
2. *Pruning within limits (applicant must define limits).*
3. *Pest control.*
4. *Mulching.*
5. *Mowing (if any).*
6. *Protection of the root zones from equipment, construction and related materials, etc.*
7. *Method of irrigation.*
8. *Other continuing maintenance operations."*

H. Standard Construction Plan Layout



I. Detail A: Standard Title Block

(NAME) SUBDIVISION PHASE (NO.) (REVISION NO.) **Wake Forest, N.C.**		
Owner(s)		
Address		
Phone		
E-mail Address		
NAME OF CONSULTING ENGINEERS	SURVEYED:	APPROVED:
	DRAWN:	DATE:
	CHECKED:	SCALE:

J. Detail B: Approval Dates*

THESE PLANS HAVE BEEN APPROVED FOR CONSTRUCTION BY THE TOWN OF WAKE FOREST.

Engineering Department	***Date***
Public Works Department	***Date***
Erosion & Sediment Control	***Date***
Fire Prevention	***Date***
Accessibility	***Date***
Planning Department	***Date***
City of Raleigh Public Utilities Department	***Date***

*Provide Detail B on all construction plan sheets.

K. Detail C: Installation Instructions

ALL PUBLIC FACILITIES, INCLUDING UTILITIES, SIDEWALKS, AND HANDICAP RAMPS ARE TO BE CONSTRUCTED ON ALL STREETS AS SPECIFIED BY TOWN STANDARDS. THESE FACILITIES HAVE BEEN APPROVED BY THE TOWN OF WAKE FOREST AND SHALL BE SO INSTALLED UNLESS A CHANGE IS APPROVED BY THE TOWN OF WAKE FOREST.

L. Detail D: Review Engineer Disclaimer

EXECUTION OF THIS CONSTRUCTION PLAT BY THE REVIEW ENGINEER FOR THE TOWN OF WAKE FOREST IN NO WAY LIMITS THE RESPONSIBILITY OF THE OWNER AND ENGINEER OF RECORD WITH REGARD TO COMPLIANCE WITH ALL FEDERAL, STATE, AND LOCAL STANDARDS AND/OR CONDITIONS.

M. Detail E: Owner Certificate

OWNER HEREBY CERTIFIES AND AGREES TO TAKE SUCH ACTION AS MAY BE REQUIRED BY THE TOWN OF WAKE FOREST TO CORRECT ANY ERRORS, OMISSIONS OR NON-COMPLIANCE WITH TOWN STANDARDS AND/OR CONDITIONS DESCRIBED IN THIS CONSTRUCTION PLAT, INCLUDING RE-SUBMISSION OR RE-EXECUTION OF THIS CONSTRUCTION PLAT WITH THE APPROPRIATE CORRECTIONS AND/OR REVISIONS.

_____ _____

Owner Date

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7 INDEX & BIBLIOGRAPHY

(Revised 5/27/14)

7.1 BIBLIOGRAPHY

7.1.1 STORMWATER MANAGEMENT

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8 BOARDWALK & FOOTBRIDGE DESIGN CRITERIA

(Rev 3/09/15)

8.1 INTRODUCTION

The following division has been established to assist engineers with the design of Greenway Boardwalks and Footbridges where applications involve public structures within the jurisdiction of the Town of Wake Forest. The methods, procedures, design factors, formulas, graphs, and tables presented in this division are intended to establish minimal guidelines for design. The Town of Wake Forest believes that the following design criteria are sufficient to ensure the welfare and safety of the general public and to protect the economic investment of the citizens of our Town.

Alternative design methods may be considered by the Engineer/Designer on a case-by-case basis; however, there should not be extensive variations from the criteria and procedures within this division without the expressed approval of the Town's Engineer.

8.2 TOWN OF WAKE FOREST TOWN'S ENGINEER

The Town's Engineer shall be responsible for interpretation and implementation of the Greenway Boardwalk and Footbridge design criteria for the Town of Wake Forest. Approval from other applicable agencies may be required.

Provided that boardwalks and footbridges are located on publicly maintained Right-of-Way and/or established public easements where such structures are an integral part of a public transportation system, the Town may accept boardwalk or footbridge systems for maintenance if they have been designed and constructed in accordance with the provisions of this specification or as otherwise instructed in writing by the Town's Engineer.

8.3 RELATED DOCUMENTS/AGENCIES

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.

B. NC State Building Code, latest edition.

C. Currently adopted edition of the NC State Building Code, Chapter 11, Accessibility.

D. International Code Council *ICC/ANSI A117.1*, latest revision (pertaining to accessibility requirements for general site and building elements)

E. AASHTO's Standard Specifications for Highway Bridges, latest revision.

F. AASHTO LRFD Guide Specifications for Design of Pedestrian Bridges.

G. FHWA *The Manual of Uniform Traffic Control Devices*, latest revision.

H. *National Design Specification for Wood Construction* (NDS), latest revision.

I. American Institute of Steel Construction (AISC), latest edition.

J. American Institute of Timber Construction (AITC), latest edition.

K. Building Code Requirements of Reinforced Concrete, American Concrete Institute (*ACI 318*) latest revision.

L. NCDOT Greenway Construction Standards *Minimum Pavement Design Recommendations for Greenways*.

M. NCDOT *Complete Street Guidelines*, latest revision

N. Occupational Safety and Health Administration (OSHA), CFR 29, Part 1910, Subpart D, latest revision.

O. Town of Wake Forest UDO, Appendix B, MSSD, Specification Section 02210 – *Trenching, Backfilling, & Compaction of Utilities*.

P. Town of Wake Forest UDO, Appendix B, MSSD, Specification *Section 02200 – Earthwork*.

Q. Town of Wake Forest UDO, Appendix B, MSSD, Specification Section 02400 – *Base Course*.

R. Town of Wake Forest UDO, Appendix B, MSSD, Specification Section 02600 – *Paving*.

S. Town of Wake Forest UDO, Appendix B, MSSD, Specification Section 02700 – *Drainage*.

8.4 DEFINITIONS

A.	**AASHTO**	American Association of State Highway and Transportation Officials
B.	**MUTCD**	Manual of Uniform Traffic Control Devices
C.	**NCDOT**	North Carolina Department of Transportation
D.	**OSHA**	Occupational Safety and Health Administration
E.	**USC**	Unified Soil Classification

8.5 PURPOSE

8.5.1 BOARDWALKS:

Boardwalks provide the opportunity to place a trail through an unavoidable environmentally sensitive area with the least amount of impact by either the trail or the trail users. Also, boardwalks are typically required when crossing wetlands or other poorly drained areas. They are often constructed of wooden planks or recycled material planks that form the top layer of the boardwalk. Recycled material has gained popularity in recent years since it lasts much longer than wood, especially in wet conditions. A number of low-impact support/foundation systems are also available that reduce the disturbance within wetland or poor soil conditions.

8.5.1 FOOTBRIDGES:

Footbridges are used where the span of water is too large for a culvert, where there is a wetland area or other environmentally sensitive area, or to cross a stream or river. Some bridges often used for multi-use trails include simple or multi-span stringers (steel, timber, or reinforced concrete), prefabricated timber or steel truss bridges, and suspension bridges.

8.6 DESIGN - GENERAL

8.6.1 BOARDWALK OR FOOTBRIDGE DESIGN ENGINEER.

Boardwalk and Footbridge design shall be performed by a Professional Engineer licensed in the State of North Carolina.

8.6.2 BOARDWALK DESIGN

A. Foundation: The foundation normally consists of precast concrete pedestals, timber posts or pilings, or augured piers (screw anchors). Screw anchors are typically constructed of hot dipped galvanized steel and last much longer than timber.

B. Abutment: Footbridge or boardwalk abutments shall consist of decay resistant material such as precast or cast-in-place concrete, pressure treated timber, or reinforced concrete masonry units with stone cladding.

C. Boardwalks offer opportunities for building seating and signage into boardwalks. Coordinate the incorporation of such features with the Town's Engineer.

D. Where hazardous drop-offs or uses exist (such as active rail lines), provide railings and/or fences.

E. In multi-use trails or greenways serving cyclists, avoid pickets in handrails or guardrails as pickets pose a hazard for bicyclists. See Table 8.1 below. Also, consult with other local, state and federal codes to determine when it is appropriate to install railing should there be a more restrictive requirement.

F. See Tables 8.1 and 8.2 for other design criteria.

8.6.3 FOOTBRIDGE DESIGN

A. Providing a standardized footbridge design is impractical due to the varied field conditions often encountered in boardwalk and footbridge design. A crossing can encounter a fixed man-made object such as a road or trail, a stream (which can vary in width, flow and turbulence), a swale, a buffer, or the crossing may even need to be curved or skewed. For these and other reasons, each footbridge must be designed individually taking into consideration the site constraints and the minimum design standards provided herein.

B. Certain styles or material may be required to be employed in the footbridge design in order to match the theme of a surrounding development or one prescribed by the Town of Wake Forest.

1. Bridge Styles & Types: See paragraph 8.7.5, Footbridge Styles & Types for an example of the typical styles of prefab bridges preferred by the Town.

C. The footbridge design shall follow the minimum design requirements below in addition to the requirements of AASHTO LRFD Guide Specifications for Design of Pedestrian Bridges, latest edition, as applicable.

D. If a corridor already contains a bridge, such as an abandoned rail bridge, an engineer shall be consulted to assess the structural integrity before deciding to remove or reuse the bridge.

E. Foundation/Abutment:

1. Foundation and abutment design should be performed by a licensed NC Professional Engineer.

2. For bridge spans greater than 25 feet, the Designer should consult with a Geotechnical Engineer for possible subgrade investigation and foundation design; particularly where micro piles, helical piering or pneumatically driven piles may be required.

3. The bridge abutment shall be placed a minimum of 10 feet back from the top of the bank of any stream. The Town's Engineer may require armor along the bank to protect the abutment.

4. The minimum free board from the bottom of the low chord to the BFE shall be 3 feet. However, overtopping of bridge structure will be acceptable with the approval of the Town's Engineer provided the design takes into consideration the dynamic and buoyancy forces imposed by the moving water with allowances for debris impact.

5. Bridge piers are not permitted to be placed in the stream channel.

6. Flood Study: Where boardwalks or footbridges are crossing a mapped floodplain with a floodway, a CLOMR, LOMR or a No-Net Rise certification shall be obtained prior to construction.

7. Coordinate setting of bridge deck elevation with the permit requirements of the applicable permits (i.e. wetlands, buffers, etc.)

F. See Tables 8.1 and 8.2 for other design criteria.

8.7 MINIMUM DESIGN CRITERIA FOR BOARDWALKS AND FOOTBRIDGES

To ensure that boardwalks and footbridges placed on public rights-of-way or easements are constructed to achieve the desired life and performance, the designer shall incorporate the minimum design guidelines specified herein. The designer shall consider all internal and external forces imposed by the loading conditions that the boardwalk or footbridge system may encounter which includes, but is not necessarily limited to gravity loads (pedestrian, equestrian, and maintenance equipment), rolling loads, impact, hydrostatic pressures, seismic, pedestrian/guardrail forces, etc.

8.7.1 GEOMETRIC DESIGN CRITERIA:

Table 8.1

Boardwalk & Footbridges Geometric Design Criteria	
Element	**Requirement**
Lanes	Two-way, multi-purpose (coordinated with trail requirements)
Clear Travel Width	10 feet minimum. For shared-use facilities, a minimum width of 14 feet is recommended (to be confirmed with Town's Engineer).
Maximum Longitudinal Grade	2%
Cross-slope	If not free draining, 2% max.
Design Speed	20 mph (no superelevation)
Minimum Horizontal Radius	95 feet

Boardwalk Intersections	Minimum 20-foot isosceles triangle return at corners (see photo below)
When is a railing needed?	**Non ADA:** Whenever the height of boardwalk exceeds 30 inches (measured vertically from the deck floor to the grade below any point within 36 inches horizontally of the edge of the Boardwalk or Footbridge. **ADA:** Meet the requirements of ICC/ANSI A117.1 and Chapter 11 *Accessibility* of the NC State Building Code, latest edition as applicable. See paragraph 8.7.4.C Rail System Selection for rail selection.
When are curbs required on Footbridges?	Whenever the drop off height from the top of an elevated boardwalk or footbridge to the adjacent grade exceeds 4 inches. When a curb is required, the curb height is to be minimum 6 inches (nominal in terms of timber curbs).
Railing Height	Pedestrian hand railing height = 42 inches
	Multi-use, Bicyclist or Equestrian Rail Height = 54 inches above the deck
	Rub rail for cyclists = 33 to 36 inches above the deck
	See paragraph 8.7.4 for railing requirements.
Picket Style	Horizontal top, middle and bottom rail (Type 3 railing system). Avoid picket style due to safety hazard to bicyclist. See paragraph 8.7.4.C Rail System Selection.

[a]A walking surface with a rise of more than 1 inch per 20 inches of run is considered a ramp.
[b]Meet ADA requirements where applicable. For accessible areas, where the grade is 5% or less, provide a level rest area, 5 feet in length, at intervals at not more than 200 feet (ref ANSI A117.1, section 405.1).

8.7.2 STRUCTURAL DESIGN CRITERIA

A. Unless otherwise advised by the Town's Engineer, the minimum structural design criteria for boardwalks and footbridges shall comply with Table 8.2, below. However, there are applications where the live load may need to be increased or decreased based on the occupancy/usage type (e.g. emergency vehicle, H10 truck loading (20,000 lb vehicle) [or even HL-93], ramp, overlook, etc.). In those cases, the Town's Engineer will make the determination. Table 8.2 summarizes the minimum structural design criteria required by the Town of Wake Forest.

Table 8.2

Boardwalk & Footbridges Minimum Design Criteria	
Design Loads	
Element	**Live Load**
Boardwalks (decks/floors, stringers and their immediate supports):	90 psf (patterned to produce the maximum load effects)
Footbridges (decks/floors, stringers and their immediate supports):	90 psf (patterned to produce the maximum load effects)
Equestrian Load (decks intended to carry equestrian loading):	1 kip over a square area measuring 4 inches on a side

Girders, trusses, arches and other members:	
Spans 0 to 100 feet	90 psf (patterned to produce the maximum load effects)
Spans > 100 feet	Refer to AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges
Maintenance Vehicle Options (Town to determine design vehicle prior to design):	
	5,000 lb Small Maintenance Vehicle such as a Gator or Mule (2,500 lbs per axle; minimum 96" wheel base)
	H5 (10,000 lbs) patterned after design vehicle; clear deck width = 10 feet[1]
Emergency Vehicle Option (Town to determine necessity prior to design):	15,000 lb ambulance or fire truck; clear deck width over 10 feet[1]
Handrails (Pedestrian Loading):	
Uniform Load (applied in any direction at the top)	50 plf[2]
Concentrated Load (applied at any direction at the top)	200 lbs[2]
Handrail Components:	
Intermediate rails, balusters, panel fillers	50 lbs[3]
Curb Loading (Pedestrian, Bicyclists):	50 plf at top of curb
Vehicle Barrier Systems (Town to determine need prior to design):	Refer to AASHTO Standard Specification for Highway Bridges
Vehicular Curb Loading:	500 plf at top of curb
Wind Load on Structure	
For girder and slab type footbridges	Refer to AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges
Other type bridge structures:	Refer to AASHTO Standard Specification for Highway Bridges
Soil Bearing Capacity (for concrete footings):	2,000 psf minimum
Stability	**Minimum Factor of Safety**[4]
Sliding	1.5
Overturning	2.0
Bearing Capacity	2.0
Wind	1.33
Impact (from moving vehicles)	1.3
Uplift (Buoyancy)	1.5
Flood Load	See ASCE10
Other Considerations:	
Deflection (unfactored pedestrian live load or unfactored horizontal wind load):	1/500 of the span length[4]
Seismic	Refer to AASHTO LRFD Guide

	Specifications for the Design of Pedestrian Bridges

1. This is the minimum Design Load. Verify loads of actual equipment utilizing the structure are below this load requirement or increase design load requirement. Refer to *AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges*.
2. Uniform or concentrated design loads shown are based on the requirements of the North Carolina State Building Code as may be applicable to ramps, decks or observation platforms. Load is not to be applied current with uniform load on handrail. Otherwise, handrail/guardrail lateral design force and top chord stability shall follow the applicable requirements of *AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges* or OSHA 1910, Subpart D as applicable to the type rail. See paragraph 8.7.4.C for rail selection criteria and thus the design requirement.
3. Load applied horizontally on an area equal to one square foot, including openings and space between rails (based on the requirements of the North Carolina State Building Code as may be applicable to ramps, decks or observation platforms).
4. Where governing design code is more restrictive, the governing design code shall apply.

8.7.3 OTHER DESIGN CONSIDERATIONS:

A. **Vehicle Considerations:** Determine the type of vehicles (maintenance [light or heavy], emergency vehicles) that will utilize the facility from the Town's Engineer and design accordingly. See Table 8.2, above for live load requirements for the respective vehicles. For emergency vehicles, the clear deck width will need to be adjusted to accommodate the width of the vehicle plus a minimum clearance of 18 inches on each side.

B. **Internal Forces**: Self-straining forces arising from contraction or expansion resulting in temperature change, shrinkage, change in moisture content, creep in component materials, movement due to differential settlement or combinations thereof.

C. **Load Combinations**: Applicable loads shall be considered, including gravity (uniform and concentrated), flood, earthquake and wind, in accordance the specified load combinations. Each load combination shall also be investigated with one or more of the variable loads set to zero. Refer to combinations identified in *AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges*.

D. **The Potential for Slick Surfaces:** Wood surfaces in shaded or moist areas may become slick or even grow moss. A means for mitigating such localized surface conditions should be considered and discussed with the Town's Engineer. Below are two options for consideration or discussion with the Town's Engineer.

1. **Hardware Cloth Option:** Slick surfaces can be managed by attaching ½-inch hardware cloth (wire mesh), especially where boardwalks follow creek grade. Fasten with 1 ½-inch heavy-duty rust resistant staples placed approximately 8 to 12 inches apart. Upper side of mesh should have wires perpendicular to direction of travel. Ends of hardware cloth should be tucked between deck boards or lapped over sides and stapled every 4 to 6 inches.

2. **Textured Paint:** Depending on site conditions, a sand-based textured coating can be applied to mitigate slick surfaces. Submit cut sheets on product, application rates, and adherence to substrate material.

3. **Annual Cleaning:** An annual cleaning (after autumn leaves fall) is recommended.

E. **Permitting**: The designer shall be responsible for ensuring all permits either will be or have been acquired where Boardwalks or Footbridges encroach into wetlands, riparian buffers or other environmentally sensitive area.

G. **Lighting of Boardwalks and Footbridges**: The Town may require that certain corridors be lit for safety. Lighting standards, spacing, and fixture specifications will be provided to the Designer by the Town's Engineer when such is required.

H. **Recycled Plastics:** The designer shall submit to the Town's Engineer, with their design, a cut sheet showing the physical characteristics and structural properties of the recycled plastics upon which the design is based. Life expectancy as well as deflection and creep shall be specifically addressed.

I. **Unauthorized Vehicular Access to Boardwalks and Bridges:** A lockable low profile heavy duty hinged bollard shall be placed at both ends of a boardwalk and footbridge to prevent unauthorized entry of vehicles. See Standard Detail 8.15.

J. **Railing Selection**: See paragraph 8.7.4.C, Railing System Selection, below.

K. **Footbridge/Boardwalk Approach Pad**: Provide a 10-foot long 6-inch thick 3000 psi concrete approach pad at each end of a boardwalk or footbridge. Width of approach pad to match width of boardwalk or footbridge. Provide temperature expansion/contraction reinforcement in the form of a sheet(s) of 6x6-W2.9xW2.9 welded wire fabric (WWF). Concrete to be air-entrained. See Standard Detail 8.05.

L. **Maintenance:** Longevity and maintenance costs shall be considered in the selection of the style and composition of a boardwalk or footbridge. The Town's Engineer may request a life cycle cost analysis be performed by the designer for non-standard bridges and particularly when specialty bridges are being considered.

8.7.4 BARRIERS/GUARDRAILS/HANDRAILS FOR BOARDWALKS & FOOTBRIDGES:

A. Where the difference in elevation between the top of the boardwalk or footbridge deck and the adjacent lower grade exceeds 30 inches, a handrail or guard barrier shall be provided. Guard rails that perform as a protective barrier for pedestrians shall be a minimum of 42 inches in height.

Where handrails or guard barriers are required, the rails or barriers are to be designed to accommodate the applicable lateral loads based on the type facility, the rail system type and the governing design code (i.e. Building Code, AASHTO, or OSHA): See Table 8.2, above.

B. **Railing Systems:** The three basic rail systems[1] typically used for footbridges include:

1. **Type 1 – Urban and high-risk areas (NC State Building Code-based)**: The 2012 NC State Building Code (2009 International Building Code [IBC]) refers to the rail systems attached to buildings as guards. These rail systems are recommended on boardwalks and footbridges in urban settings or high-use areas. The NC State Building Code section 1013, "Guards," requires stairs, platforms, and landings higher than 30 inches to have guards (rail systems) at least 42 inches high measured from the leading edge of the tread to the top of the guard. A 4-inch sphere must not pass through the

[1] USDA Trail Bridge Rail Systems, December 2007 (modified/updated by Appian Consulting Engineers, PA)

lower 34 inches of the rail system and an 8-inch sphere must not pass through the upper area of the rail system (between 34 and 42 inches). The NC State Building Code section 1607, "Live Loads," requires guards to resist a uniform load of 50 pounds per linear foot or a single concentrated load of 200 pounds applied in any direction at the top of each rail. The guard must transfer the load through the supports to the structure. Most intermediate rails are mounted vertically so children cannot climb on them.

2. **Type 2 – Rural and moderate-risk areas (AASHTO-based)**: Rail systems on boardwalks or footbridges frequently used by pedestrians, bicycles, light maintenance equipment and other moving traffic should meet the "AASHTO LRFD (Load and Resistance Factor Design) Bridge Design Specifications". Section 13, "Railings," requires a railing (rail system) at least 42 inches high for pedestrian traffic and at least 54 inches high for bicycle or equestrian traffic. A 6-inch sphere must not pass through the lower 27 inches of the rail system and an 8-inch sphere must not pass through the upper area of the rail system (higher than 27 inches). A safety toe rail (AASHTO's terminology) or curb should be provided. The rail spacing requirements do not apply to support rails and posts for chain link or metal fabric fence. Mesh in chain link or metal fabric fence should have openings no larger than 2 inches. The design live load for railings is 50 pounds per linear foot, both transversely and vertically, acting simultaneously. In addition, each rail will be designed for a concentrated load of 200 pounds, which shall act simultaneously with the above loads at any point and in any direction at the top of each rail. Note: Railings (rail systems) are normally constructed horizontally so wheels will not catch on them.

3. **Type 3 – Remote and low-risk areas (OSHA-based)**: The NC State Building Code and AASHTO rail systems are complicated and expensive and should be used for moderate- to high-risk areas. Remote locations are typically low-risk areas and may not have to meet these standards. The Occupational Safety and Health Administration (OSHA, CFR 29, Part 1910, Subpart D) refers to a rail system as a standard railing. These systems provide safety without complication and are widely accepted for protecting industrial workers. While OSHA requirements apply only to the workplace, its standard railing is a good choice for public trail bridges in low-risk areas. OSHA 1910.23 requires every open-sided floor or platform 4 feet or more above the adjacent floor or ground level to be guarded by a standard railing on all open sides except where there is an entrance to a ramp, stairway, or fixed ladder. A standard railing shall consist of a top rail, intermediate rail, bottom rail, and posts. The railing shall have a vertical height of 42 inches nominal from the upper surface of the top rail to the floor, platform, runway, or ramp. The intermediate rail shall be about halfway between the top rail and the floor, platform, runway, or ramp. A bottom rail (called a toeboard by OSHA) is recommended. For pedestrian trail bridges, the vertical distance between steel rails must not exceed 19 inches and the vertical distance between wood rails must not exceed 15 inches. The completed rail system shall be capable of withstanding a load of at least 200 pounds applied in any direction at any point on the top rail. Note: For Type 3 Railing Systems, rails will be required when the decking is greater than 30 inches above the lower adjacent grade as stated in Table 8.1.

4. **Types 1, 2, & 3 – Multi-use or Bicyclist Rail Height**: Multi-use, bicyclist or equestrian rail height shall be a minimum of 54 inches above the deck with a rub rail for cyclists at 33 to 36 inches above the deck.

C. **Railing System Selection**:

Type 1: Type 1 railings systems are to be used for boardwalks and footbridges where the vertical separation is greater than 30 inches, the conditions pose a significant fall hazard (such as overpasses or stream and river crossings) and the facility traffic is limited to pedestrian, bicycle, equestrian, and small maintenance equipment. The applicability or use of this type railing system shall be determined by the design engineer and approved by Town's Engineer.

Type 2: Type 2 railings systems are to be used for boardwalks and footbridges where the vertical separation is greater than 30 inches, the conditions pose a significant fall hazard (such as overpasses or stream and river crossings) and the facility will serve pedestrians, bicycles, equestrian, small maintenance equipment, H5 loading or larger maintenance equipment, and/or emergency equipment. If a vehicle barrier is required in addition to or as part of a pedestrian railing system by the Town's Engineer, the barrier design shall conform to the requirements of Table 8.2. The applicability or use of this type railing system shall be determined by the design engineer and approved by Town's Engineer.

Type 3: Type 3 railing systems are to be used for boardwalks and footbridges where the vertical separation is greater than 30 inches and traffic is limited primarily to rural areas serving pedestrian, bicycle, equestrian, and small maintenance equipment. Unless otherwise necessitated by design requirements, trail type or when directed by the Town's Engineer, Type 3 railing systems shall the standard rail type typically employed for boardwalks and footbridges.

8.7.5 FOOTBRIDGE STYLES & TYPES:

A. For the purpose of consistency, the footbridge style or type shall take the appearance of one or more of the following. For consistency, try to utilize a single style along the entire trail under design consideration unless the span dictates otherwise. Other styles and configurations will be considered by the Town's Engineer on a case-by-case basis.

Short Span Bridges (8 to 40 feet+/- span)

Timber or Steel Stringer Style
(Glulam Bridge shown)
May be single or multi-span

Medium Span Bridges (40+/- to 100 feet+ Span)

Pratt Half Through Truss

(See also Standard Detail 8.13 for example of a Bowstring Pratt half through truss)

Warren Half Through Truss

Specialty & Long Span (100 to 200+ feet)

Specialty Bridges

(As approved by the Town's Engineer considering topography, aesthetics of crossing, location, span, materials and maintenance). Specialty bridge systems may be part of a multi-span system made up of trusses or a single truss with stringer-style single or multi-span approaches.

Tied Arch Style with suspension cables to deck shown

8.8 MATERIALS:

Acceptable Materials for boardwalks and footbridges shall comply with Table 8.3. However, the Town's Engineer will consider alternate material substitutions on a case-by-case basis.

Table 8.3

Acceptable Materials	
Boardwalk & Footbridge Material	
Material	**Product or Manufacturer**
Decking Material:	Non-toxic pressure treated wood such as TimberSIL (infused glass) or an approved equal.

	Naturally rot resistant (such as Red Cedar)
	Recycled plastic
	Precast concrete boardwalk system (such as PermaTrak™) Standard widths = 3'-9", 7'-6", 11'-3" and 15"-4". Thickness = 4" and 5 ½" Engineered Code Requirements: H5 (10,000 lbs). Slip Resistant
Timber Joist, Beam, &Truss Material	Non-toxic pressure treated wood
	Naturally Decay Resistant Timber such as Red Cedar or Black Locust
Steel Joist, Beam &Truss Material	Self-weathering steel, galvanized, Aluminum or paint on non-weathering steel surfaces meeting NCDOT Standard Specification for Roads and Structures, latest revision, Sections 442 and 1180, as applicable; color approved by Town's Engineer.
Foundation Support:	
Precast Footings	Precast concrete pedestals with precast concrete bases on an approved subgrade or improved foundation.
Dimensional Piles:	Non-toxic pressure treated timber
	Recycled Plastic Posts
	Precast reinforced concrete
Galvanized Helical Steel Piers	Augur-like helical anchors that can be screwed in to the soils with little disruption to the ecosystem environment such as manufactured by Hubbell Power Systems – Civil Construction.
Galvanized Pin Foundations	Patented by Pin Foundations, Inc., the system uses 4- to 8-foot long sections of galvanized pipe sections driven into the ground at diagonal angles. Pins can be pulled up to permit adjustments or removal. See Standard Detail 8.12 for an example of this foundation system.

Concrete Foundation	Precast Concrete abutments (slabs, tees, or special cast shapes)
	Cast-in-place reinforced concrete (rubbed or textured finish or clad in natural stone veneer)
	Reinforced concrete masonry block (clad with natural stone veneer if visible to public)

8.9 POSTING A LOAD RATING

Each approach of each section of boardwalk or footbridges shall be posted with sign indicating the structures safe load rating. Signs shall match the greenway system signage.

8.10 OVERPASSES:

A. Where footbridges are designed as overpasses (over existing roadways), safety should be the primary consideration.

B. A signature bridge should be considered in areas of high visibility, such as over major roadways. This may include special LED lighting elements for nighttime enhancement/visibility.

C. Aesthetically pleasing galvanized steel debris netting (or other approved style and color) shall be provided on both sides and up over the top to at least 8 feet above the decking. Mesh shall be minimum 2x2.

D. For shared-use facilities, a minimum width of 14 feet is recommended.

8.11 UNDERPASSES:

A. An underpass is typically a crossing constructed beneath a new or existing roadway. Underpasses work best with favorable topography when they are open and accessible, and exhibit a sense of safety.

B. An underpass can also be a trail crossing beneath an existing overhead roadway bridge where such structures cross streams or rivers. The underpass must be large enough to accommodate trail users and meet the prescribed clearances. In some cases, a protective housing, such as a multi-plate arch or other similar structure, can be placed beneath the overpass to protect trail users from falling objects (such as railroad ballast, etc.).

C. Proper drainage must be established to avoid pooling of stormwater; however, some underpasses can be designed to flood periodically (after significant rainfall).

D. Ideal vertical clearance of the underpass is 12 feet but, with the approval of the Town's Engineer, may be reduced to no less than 10 feet.

E. The width of an underpass shall be at least 12 feet.

F. Headwalls and wingwalls are required on both ends.

G. Longitudinal grade shall be no less than 1%.

H. Illuminance: Underpasses should have a daytime illuminance of 10 foot-candles minimum achievable through artificial and/or natural light provided through an open gap to the sky between two sets of highway lanes. Nighttime illuminance level: 4 foot-candles.

I. See Standard Detail 8.14.

8.12 REFERENCES

1. *2012 NC State Building Code* (2009 IBC w/ NC Amendments)

2. American Association of State Highway and Transportation Officials (AASHTO), *Standard Specifications for Highway Bridges*, Washington DC, 16th Edition, 1996 with 1997 and 1998 Interims.

3. American Association of State Highway and Transportation Officials (AASHTO), *AASHTO LRFD (Load and Resistance Factor Design) Guide Specifications for the Design of Pedestrian Bridges,* 2nd Edition, w/ 2015 Interim Revisions.

4. Photo Credit: "Riverwalk" photo image showing isosceles corners on footbridge courtesy of Cline Design Associates, PA, Raleigh, NC, 919.833.6413.

5. USDA Trail Bridge Rail Systems, December 2007, http://www.fs.fed.us/t-d/pubs/htmlpubs/htm07232329/

6. OSHA Part 1910 Subpart D, Waling-Working Surfaces 1910.23, Guarding Floor and Wall Openings and Holes, https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9715

8.13 APPENDIX OF TABLES

The following Tables are being provided for both convenience and reference.

Table A.1

Approximate Soil Design Parameter Ranges					
Wall Backfill Classification	**Common Description**	**UNSC Classification**	**Φ range**	**γ range (moist)**	**Comments**
Good	Sand, Gravel, Stone	GW, GP, GM, GC, SW, SP	32° - 36°	100 -135 pcf	Poor grading lowers weight (i.e. #57 stone)
Moderate	Silty Sands Clayey Sand	SM, SC	28° - 32°	110 – 130 pcf	Moisture Sensitive
Difficult	Silts, Low Plastic Clays	ML, CL, CL	25° - 30°	110 – 125 pcf	PI<20 LL<40
Bad	High Plastic Silts & Clays, organics	CH, MH OH, PT	0° - 25°	50 – 110 pcf	PI<20 LL<40

Table A.2

PRESUMPTIVE BEARING CAPACITIES[a]		
CLASS	**MATERIAL**	**ALLOWABLE BEARING (tons per sq. ft.)[b]**
3	Hard weathered rock	30
4	Soft weathered rock	15
5	Hard residual silt/dense sand	5
6	Residual silt/sand	1 to 3
7	Dense sand	3
8	Stiff clay	2
9	Loose sand	1
10	Soft clay	1
11	Compacted controlled fill	1.5

a. Partially excerpted from Table 1806.2 of the 2012 NCSBC.
b. The allowable bearing value given in this section or when determined in accordance with the provisions of Section 1806.2.1 of the 2012 NCSBC will assure that the soils will be stressed within limits that lie safely below their strength. However, such allowable bearing pressures for class 6 and classes 8 through 11 do not assure that the settlements will be within tolerable limits for a given structure.
c. Alternatively the allowable bearing value may be calculated from soil properties determined by field or laboratory tests.

TABLE A.3

PRESUMPTIVE LATERAL BEARING PRESSURE[c]			
CLASS OF MATERIALS	**LATERAL BEARING (psf/f below natural grade)[d]**	**LATERAL SLIDING**	
		Coefficient of friction[a]	**Resistance (psf)[b]**
1. Crystalline bedrock	1,200	0.70	--
2. Sedimentary and foliated rock	400	0.35	--
3. Sand gravel and/or gravel (GW and GP)	200	0.35	--
4. Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	150	0.25	--
5. Clay, sandy clay, silty clay, clayey silt, silt and	100	--	130

sandy silt (CL, ML, MH and CH)			

a. Coefficient to be multiplied by the dead load.
b. Lateral sliding resistance value to be multiplied by the contact area, as limited by Section 1806.3 of the 2012 NCSBC.
c. Deleted
d. Deleted
e. Excerpted from Table 1806.2 of the 2012 NCSBC

TABLE A.4[c]

SOIL LATERAL LOAD			
DESCRIPTION OF BACKFILL MATERIALS	**UNIFIED SOIL CLASSIFICATION**	**DESIGN LATERAL SOIL LOAD[a] (pound per square foot per foot of depth)**	
		Active pressure	**At-rest pressure**
Well-graded, clean gravels; gravel-sand mixes	GW	30	60
Poorly graded clean gravels; gravel-sand mixes	GP	30	60
Silty gravels, poorly graded gravel-sand mixes	GM	40	60
Clayey gravels, poorly graded gravel-and-clay mixes	GC	45	60
Well-graded, clean sands; gravely sand mixes	SW	30	60
Poorly grades clean sands; sand-gravel mixes	SP	30	60
Silty sands, poorly graded sand-silt mixes	SM	45	60
Sand-silt clay mix with plastic fines	SM-SC	45	100
Clayey sands, poorly graded sand-clay mixes	SC	60	100
Inorganic silts and clayey silts	ML	45	100
Mixture of inorganic silt and clay	ML-CL	60	100
Inorganic clays of low to medium plasticity	CL	60	100
Organic silts and silt clays, low plasticity	CL	Note b	Note b
Inorganic clayey silts, elastic silts	MH	Note b	Note b
Inorganic clays of high plasticity	CH	Note b	Note b
Organic clays and silty clays	OH	Note b	Note b

a. Design lateral soil loads are given for moist conditions for the specified soils at their optimum densities. Actual field conditions shall govern. Submerged or saturated soil pressures shall include the weight of the buoyant soil plus the hydrostatic loads.
b. Unsuitable as backfill material
c. Excerpted from Table 1610.1, 2012 NCSBC

bj.Town of Wake Forest.Greenway Specs.Greenway Bridges Final.doc

00825 - PRODUCT SUBSTITUTIONS

(Last revised 3/09/15)

PART 1 - GENERAL

1.1 PRODUCT SUBSTITUTIONS

1.1.1. PRODUCT SUBSTITUTIONS:

A. Trade names, brand names, and/or manufacturer's information used in these specifications are for the purposes of establishing quality. Bids on products or other qualified manufacturers are acceptable provided request is made in writing not less than 10 days prior to scheduled receipt of bids, and provided the product has been previously approved by the Town of Wake Forest's Product and Design Review Committee (PDRC) and provided that:

1) No major changes in the construction, design intent, or to any services or modifications to other equipment of the project would be required. Changes required to accommodate substituted items or the cost to repair and damage resulting from effecting such changes or modifications made necessary or caused by substitution shall be made by the Contractor at no additional cost or time delay.

2) Features of quality, capacity, construction, performance, appearance, size, arrangement, and general utility including economy of operation of substitutes offered, either parallel or exceed those of specified products.

B. Technical data covering the proposed substitution shall be furnished with the request.

1.2 PRODUCT AND DESIGN REVIEW COMMITTEE (PDRC)

1.2.1. HOW TO HAVE YOUR PRODUCTS AND DESIGNS APPROVED BY THE TOWN OF WAKE FOREST:

A. **Evaluation Process:**

1) Who is Eligible? Anyone interested in having their company's products and designs approved by the Town of Wake Forest.

B. **How to apply:**

a. The committee meets on the second Friday of each month or as needed.

b. **Formal Request**: A formal written request must be submitted to the committee at least 60 days prior to the date of the presentation. This request should include the preferred meeting date as well as an alternate date. In addition, 7 copies of this request must be submitted along with 7 copies of all literature, specifications, and materials that might affect the decision of the committee. The submittal must include the following: detail information

about the product, cost of the product and installation if applicable, discussion of the benefit, detail list of references of current users of the product and a discussion on the product's availability to the Town of Wake Forest and time related to ordering and delivery. A sample of the product, a video and/or photos my also be provided during the presentation.

c. **Presentation**: There will be a 30-minute time limit for each presentation. Questions will be answered in a 15-minute time period after the presentation. You will be notified of your presentation date within 30 days after receipt of your request. Requests should be in writing, but phone calls will be accepted by the PDRC Committee Chairman. Representatives at the meeting should be in a position to offer any type of background on product use and locations, design, and reference checks. These representatives should also have the authority to approve a trial run in our service area.

d. **Applications**: Send all applications to:

Eric Keravuori, PE, Director of Engineering, Committee Chairman
301 S. Brooks Street
Wake Forest, NC 27587

C. **Product and Design Review Subcommittee Members:**

The PRDC is composed of the following subcommittees and members. Requests for will be forwarded to the applicable subcommittee for review and consideration.

1) Stormwater Management

a. Town Engineer

b. Assistant Town Engineer

c. Construction Inspector

d. Streets Superintendent

2) Streets

a. Town Engineer

b. Assistant Town Engineer

c. Construction Inspector

d. Streets Superintendent

3) Traffic

a. Town Engineer

b. Assistant Town Engineer

c. Construction Inspector

d. Streets Superintendent

D. **Evaluation Period:** An evaluation can take up to 12 months.

E. **Results:** After the presentation, and upon completion of the evaluation period, the committee chairman will notify the designer or vendor in writing about the committee's findings. A two-thirds vote of the members is required to approve that product or design for use in the applicable division/department.

F. The Town of Wake Forest reserves the right to limit the number of approved manufacturers and products as they deem necessary in order to control parts inventory, maintenance, and training requirements.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

End of Section 00825

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bj.Town of Wake Forest.Product_Substitutions_Product_ Comm.doc

02200 - EARTHWORK

(Last revised 9/1/15)

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

Part 1 – General
Part 2 – Products
Part 3 – Execution
Backfill/Compaction of Walls
Blasting – Insurance Require'ts
Cleanup
Clearing and Grubbing
Density Requirements
De-Watering
Dust Control
Earthwork Volume Measurement
E&S, NPDES Requirements
Geotextile Fabric
Geotextile Fabric - Products
Lift Thicknesses
NCDOT Select Mat'l Classes
Passing Tests-What Constitutes a
Quality Assurance vs Quality Control
Rock Definition-Open Excavation
Rock Excavation
Select Material Classification
Soil Stab Fabric - Placement
Structures-Excavation
Subgrade Preparation
Testing – Frequency
Topsoil - Definition
Traffic Control
Tree Root Protection
Unclassified Excavation - Def
Undercut Excavation, Definition

PART 1 - GENERAL

1.1 GENERAL

A. The Contractor shall furnish all labor, materials, tools, equipment, and perform all work and services for all site clearing, site excavation, grading and embankment, excavation, filling and backfilling for structures, such as drainage structures, curb and gutters, sidewalks, driveways, pavements, including borrow, hauling, wetting, rolling and other operations pertaining thereto within the clearing limits, complete all as shown on the contract drawings and in accordance with these Contract Documents and completely coordinated with all other trades.

B. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

C. All work on state system streets shall conform to the applicable provisions of the N.C. Department of Transportation Standard Specifications for Roads and Structures, latest edition.

Work performed on local government streets shall conform to their applicable standards and specifications except as modified herein.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements and Supplementary Conditions applicable to this specification.

B. Section 02210 – Trenching, Backfilling, and Compaction of Utilities

C. Section 02400 – Concrete Pavement, Curb & Gutter, Drives, Sidewalks

D. Section 02500 – Base Course

E. Section 02600 - Paving

F. Section 02700 – Storm Drainage

G. NCDENR Stormwater Best Management Practices Manual, latest edition.

H. NCDENR Division of Energy, Mineral and Land Resources, Land Quality Section's *North Carolina Erosion and Sedimentation Control Planning and Design Manual*.

I. OSHA *29 CFR Part 1910.109*, NCDOT Rules for Transporting Explosives, and Town of Wake Forest Inspections Department with regard to blasting.

J. OSHA 29 CFR 1926 OSHA "Construction Industry Regulations", latest revision.

K. OSHA Standard 29 CFR Part 1926, "Safety and Health Regulations for Construction," Subpart P "Excavations," Standard Number 1926.650, latest revision.

L. N.C. Department of Transportation *Standard Specifications for Roads and Structures*.

M. *N.C. State Building Code*, latest edition.

1.3 SUMMARY

A. This section includes:

1) Site clearing and grubbing.

2) Stripping and stockpiling topsoil.

3) Excavation and embankment placement.

4) Preparing subgrade for pavement, sidewalk, curb & gutter, and turfed areas.

B. Construction and materials related to this section but covered elsewhere:

1) Erosion Control: North Carolina Sediment Control Law.

1.4 DEFINITIONS

For the purposes of this specification, the following definitions refer to earthwork that comes under the authority of the Town of Wake Forest as specified within this division and other divisions of this manual.

A. **Borrow:** Select material, approved by Engineer and meeting these specifications, from an off-site borrow source.

B. **Classified Excavation:** See paragraph 1.4.Q, Undercut Excavation. See also paragraph 1.4.P, Unclassified Excavation.

C. **Clearing:** Clearing shall consist in the felling, cutting up, and satisfactory disposal of trees, shrubs, laps, other vegetation within the limits of construction, as designated on the plans or as required by the Town's Engineer, except for those indicated to be left standing. Clearing shall also consist of removal, and satisfactory disposal of all down timber, brush, rocks, rubbish, and other material within the limits of construction as

well as the clearing, removal and disposal of all improvements that have been designated to be demolished, or obstructions that interfere with new construction.

D. **Competent Person:** Competent Person means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

E. **Contractor:** Refers to a Contractor licensed in the State of North Carolina to perform grading and earthwork construction.

F. **Easement**: A grant of one or more of the property rights by the property owner for limited use of private land for a public or quasi-public purpose and within which the owner of the property shall not erect any permanent structures except when authorized by the Town. Ownership of the land remains with the second party.

G. **Fill (in terms of volume):** In terms of volume, fill is defined as a compacted post-construction volume in-place. See paragraph 3.8 Method of Volume Measurement.

H. **Grubbing:** Grubbing shall consist of the removal and disposal of all buried debris, stumps and roots having a diameter of three inches or larger to a depth of at least three feet below subgrade.

I. **Rock in Open Excavation**: All boulder, solid ledges, bedded deposits, unstratified masses, and conglomerations of material so firmly cemented as to possess the characteristics of solid rock. Rock in open excavations includes removal and disposal on-site of materials and obstructions encountered in general excavation other than trenches and pits that cannot be dislodged and excavated with modern, track-mounted, heavy-duty excavating equipment without drilling, blasting, or ripping. Rock is defined as material which cannot be effectively excavated during general grading with a D-8 or equivalent dozer drawing a new single-tooth ripper. Effective excavation is defined as the ability to remove 10 cubic yards or more of material after one hour of continuous ripping. Typical of materials classified as Rock in Open Excavation are boulders larger than 1-1/2 cubic yards or more in volume, solid rock, rock in ledges, and rock-hard cementitous aggregate deposits.

J. Rock Excavation for Trenches and Pits: Rock excavation for trenches and pits includes removal and disposal off-site of materials and obstructions encountered that cannot be practically excavated with a track-mounted power excavator, equivalent to a Caterpillar Model No. 325 or equivalent equipped with new rock teeth. Practical excavation is defined as the ability to remove at least 30 cubic yards during one hour of continuous digging. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as open excavation.

K. **Select Fill Material:** Nonplastic material, free of organic material, used as foundation for subbase, shoulder surfacing, fill, backfill, or other specific purposes. See paragraph 2.2.2. *Select Material Classification (Borrow)*.

L. **Structures:** Incidental buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

M. **Subgrade:** Surface or elevation remaining after completing the excavation, or top surface of a fill or backfill immediately below subbase or topsoil materials, as applicable.

N. **Topsoil:** A native, imported, or modified soil which is primarily organic in nature, free of rocks, clumps of clayey soils and otherwise friable in texture. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 2 inches in diameter, and without weeds, roots, and other objectionable material.

O. **Town Engineer:** The Town Engineer or his/her designated representative.

P. **Unclassified Excavation**: Removal and disposal of any and all material above subgrade elevation or within the 12 inches of existing natural grade, whichever is greater, except solid rock and undercut excavation, located within the limits of construction.

Q. **Undercut (Classified) Excavation:** Undercut excavation is defined as "all excavation below subgrade elevation or in excess of twelve (12) inches below natural ground, whichever is less." Undercut shall consist of the removal and satisfactory disposal of all unsuitable material. Where undercut excavation to the above stated depth results in a subgrade or slopes of muck, peat, matted roots, etc., the Contractor shall remove such material below the grade shown on the plans or as directed; and areas so excavated shall be backfilled with approved select fill or stone as ordered by the Town's Engineer.

1) Filling of undercut areas, unless otherwise authorized by the Engineer, shall be replaced and compacted at the Contractor's expense.

1.5 SUBMITTALS

A. **Material Test Reports**: Provide from a qualified testing agency test results and interpretation for compliance of the following requirements indicated:

1) See paragraph 1.6.A below regarding Geotechnical Testing Agency Qualifications.

2) Classification according ASTM D2487 of each on-site or borrow soil proposed for backfill, unless otherwise directed by the Town's Engineer.

3) Laboratory compaction curve according to ASTM D698 for each on-site or borrow soil material proposed for fill or backfill.

4) Laboratory compaction curve according to ASTM D1557 for each on-site borrow soil material proposed for fill and backfill.

B. **Blasting:**

1) See Town of Wake Forest Inspections.

C. **Product Data:**

1) Stabilization/Separation fabric: Submit product data and, if requested by the Town's Engineer, a sample of separation fabric and fully document each with specific location or stationing information, date and other pertinent information.

1.6 QUALITY ASSURANCE

A. **Geotechnical Testing Agency Qualifications:** An independent testing agency qualified according to ASTM E329 to conduct soil materials and rock-definition testing as documented according to ASTM D3740 and ASTM E548. Testing Lab to be AMRL (AASHTO Materials Reference Laboratory) and CCRL (Cement and Concrete Reference Laboratory) certified.

The testing laboratory shall be approved by the Town's Engineer and will be responsible for conducting and interpreting tests. The testing laboratory shall state in each report whether or not the test specimens conform to all requirements of the Contract Documents and specifically note any deviation.

Specific test and inspection requirements shall be as specified herein.

B. Comply with all codes, laws, ordinances, and regulations of governmental authorities having jurisdiction over this part of the work.

C. The Contractor shall comply with applicable requirements of NCDENR Division of Energy, Mineral and Land Resources, *North Carolina Erosion and Sedimentation Control Planning and Design Manual*, latest revisions.

D. Comply with applicable requirements of NFPA 495, *Explosive Materials Code,* latest revisions.

1.7 QUALITY STANDARDS

A. For convenience, reference is made in succeeding paragraphs to specific portions of various standards. Also, modifications and additions are made. Neither the reference nor the modifications are intended to de-emphasize any other portion of the standards.

B. It is the intent of this specification that whenever a procedure or technique is not called out herein, that the industry standard, as represented by ACI, ASTM or other appropriate recommendation, shall be used.

C. Perform all work in accordance with requirements of local and state codes, with requirements of OSHA, and in accord with federal requirements.

D. Materials and operations shall comply with the latest revision of the Codes and Standards listed below:

American Society for Testing and Materials

ASTM C33	Concrete Aggregates
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils
ASTM D698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft) (Standard Proctor)

ASTM D1556	Standard Method of Test for Density of Soil in Place by the Sand-Cone Method
ASTM D1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb./ft) (Modified Proctor)
ASTM D1883	Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D2049	Standard Method of Test for Relative Density of Cohesionless Soils
ASTM D2167	Standard Method of Test for Density of Soil in Place by the Rubber-Balloon Method
ASTM D2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D2937	Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
ASTM D3740	Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D4254	Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
ASTM D4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E329	Standard Specification for Agencies Engaged in Construction Inspection and/or Testing
ASTM E548	Standard Guide for General Criteria Used for Evaluating Laboratory Competence

American Association of State Highway & Transportation Officials

AASHTO T99	The Moisture-Density Relations of Soils using a 5.5 - pound Rammer and a 12 inch drop.
AASHTO T180	The Moisture-Density Relations of Soils using a 10 pound Rammer and a 18 inch drop.
AASHTO M145	The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

AASHTO T191	Density of Soil In-Place by the Sand-Cone Method
AASHTO T204	Density of Soil In-Place by the Drive Cylinder Method
AASHTO T205	Density of Soil In-Place by the Rubber-Balloon Method

E. **Standard Abbreviations:**

AASHTO	American Association of State Highway Transportation Officials.
ANSI	American National Standards Institute
AREA	American Railway Engineers Association
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
EPA	Environmental Protection Agency
FS	Federal Specifications
MSDS	Material Safety Data Sheets
NCDENR	NC Department of Environment and Natural Resources
NCDOT	North Carolina Department of Transportation
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Administration
USACOE	United States Army Corps of Engineers

1.8 PROJECT CONDITIONS

A. **Demolition:** Demolish and completely remove from the site existing underground utilities indicated on the plans to be removed. Coordinate with applicable utility companies to shut off services if other active utility lines are involved.

B. **Environmental - Wetlands:** Before crossing or entering into any jurisdictional wetlands, contractor shall verify whether or not a wetlands permit has been obtained for the encroachment and whether special restrictions have been imposed in that permit. Care shall be taken to prevent draining or otherwise destroying non-permitted wetlands. Restore as stated on either the project drawings, the contract documents, and/or as noted in the permit. All crossings, disturbances, and encroachments into wetlands shall be subject to USACOE and NC Division of Water Resources Water Quality Permitting Section approval and permitting requirements and conditions.

C. **Environmental - Buffer Crossing Requirements:** Before crossing streams or ditches or working within 50 feet of ponds, lakes, or rivers, the Contractor shall verify

whether either the line is exempt or a permit has been obtained to encroach into a nutrient sensitive river basin buffer and if so, to what extent work is permitted to occur. Unless otherwise permitted, shown on the contract drawings, or exempted by NCDENR or other proper authority, water and sewer crossing stream, river, pond, or lake buffers are to be as near perpendicular as possible (the crossing is considered to be perpendicular if it intersects the stream or surface water between an angle of 75 and 105 degrees). Do not disturb more than 40 linear feet (longitudinal) of riparian buffer. When permitted to encroach into zone 1 (the lower 30 feet beside the stream or water), adhere to all of the following minimum, but not necessarily limited to, Best Management Practices in during construction.

1) Woody vegetation is cleared by hand. No grading allowed.

2) Stumps to remain except in trench where trees are cut. Minimize disturbance to roots in buffer zone.

3) Backfill trench with the excavated soil immediately following installation.

4) Do not use fertilizer except for the one-time application to reestablish vegetation.

5) Minimize removal of woody vegetation, the amount of disturbed area, and the time the disturbed area remains disturbed.

6) Take measures to ensure diffuse flow of water through the buffer after construction.

7) In wetland areas, use mats to minimize soil disturbance.

8) Schedule work in buffers to ensure exposure of denuded surface in the buffer is kept to a minimum.

9) Wells: If buffer distance cannot be obtained at either a public or private water supply well, the well is to be abandoned per the requirements of the Wake County Health Department and NCAC 15A Subchapter 2C, Section .0100, *Well Construction Standards*.

D. **Geotechnical Investigation**

1) Where a Geotechnical report has been provided to the Contractor by the Town, the data on sub-surface soil conditions is not intended as a representation or warranty of the continuity of such conditions between borings or indicated sampling locations. It shall be expressly understood that the Town of Wake Forest will not be responsible for any interpretations or conclusions drawn there from by the Contractor. The data is made available for the convenience of the Contractor.

2) In addition to any report that may be made available to the Contractor, the Contractor is responsible for obtaining any other soils information he/they feels is necessary for proper evaluation of the site for the purposes of planning and/or bidding the project – at no additional cost to the Town of Wake Forest. However, the Contractor shall provide the Town of Wake Forest with a written request for site access prior to moving on the site.

E. **Protection of pavement**

Debris from the site shall be removed in such a manner as to prevent spillage. Keep pavement and area adjacent to site clean and free from mud, dirt, dust, and debris at all times. Employ the necessary measures required to meet this requirement.

1.9 SERVICE INTERRUPTION

For service interruption, operation of valves, taps, fire hydrant operation, etc, contact the City of Raleigh Public Utilities Operations Division (at 919.996.2737 between the hours of 7:30 AM and 4:00 PM. After 4:00 PM, call the afterhour's emergency number at 919.829.1930. Provide a minimum of 48 hours notice or desired utility interruption or necessary operation of valves or hydrants.

Refer to the following link regarding service interruption: http://www.raleighnc.gov/home/content/PubUtilAdmin/Articles/WaterandSewerFAQs.html

1.10 COORDINATION

A. The City of Raleigh Public Utilities Department will be the sole operator of all valves and hydrants within the Town of Wake Forest. Coordinate all utility service interruptions with the City of Raleigh Public Utilities Department.

B. Coordinate tie-ins to municipal roadway system with the Town of Wake Forest.

C. When traffic signals, loops, or their appurtenances are likely to be damaged or interfere with construction, coordinate temporary operation with the NCDOT and/or the applicable agency having jurisdiction of the signals. Provide a minimum of 1 weeks' notice prior to anticipated disturbance or interruption. At the discretion of the Town's Engineer, the notice may be required to be published in the newspaper.

D. Repair of pavement markings: When cuts are made through any paved surface and the cuts extend through the pavement markings, the replaced pavement shall be marked to match the existing.

E. Benchmark/Monument Protection: Protect and maintain benchmarks, monuments or other established reference points and property corners. If disturbed or destroyed, they must be replaced at Contractor's own expense by a Licensed Professional Surveyor and to the full satisfaction of Owner/Town of Wake Forest.

F. Contact "*NC One Call*" at 811 before digging.

1.11 PUBLIC CONVENIENCE

The contractor shall at all times so conduct his work as to ensure the least possible inconvenience to the general public and the residents in the vicinity of the work. Fire hydrants on or adjacent to the work shall be kept accessible to firefighting equipment at all times. Temporary provisions shall be made by the Contractor to ensure the proper functioning of all gutters, sewer inlets, drainage ditches, and irrigation ditches, which shall not be obstructed except as approved by the Town's Engineer.

Refer to the Town of Wake Forest Noise Ordinance by visiting the following link: http://www.wakeforestnc.gov/residents-noiseordinance.aspx

1.12 TRAFFIC CONTROL

A. When working within any NCDOT System road or highway, conform to the *Manual on Uniform Traffic Control Devices*, latest revision (MUTCD) as well as the NCDOT *Standard Specifications for Roads and Structures*, latest revision.

B. Traffic Maintenance shall comply with the latest revision of the NCDOT *Standard Specifications for Roads and Structures*, Division 9 – *Signing* and Division 11 – *Work Zone Traffic Control*, as well as other applicable sections.

C. A traffic control plan shall be submitted to the Town of Wake Forest Engineering and NCDOT (if applicable) for approval.

D. When traffic signals or their appurtenances are likely to be damaged or interfere with construction, coordinate temporary operation with the NCDOT or the Town's Engineer. Provide a 1 week notice prior to anticipated disturbance or interruption.

E. Whenever it becomes necessary to leave a section of trench open after completion of the day's work, the contractor shall provide barricades and lights to protect the public. Operate warning lights during hours from dusk to dawn each day and as otherwise required for inclement weather and visibility.

1.13 EROSION AND SEDIMENTATION CONTROL AND NPDES MONITORING, CONTROLS, AND LIMITATIONS FOR PERMITTED DISCHARGES

Refer to the town of wake forest UDO for erosion and sedimentation control requirements; chapter 12.

http://www.wakeforestnc.gov/data/sites/1/media/residents/planning/development%20services/currentudo.pdf

1.14 SAFETY

A. Ensure full compliance to applicable requirements of OSHA. Refer to 29 CFR 1926 OSHA "Construction Industry Regulations", latest revision.

B. Comply with local requirements and specific requirements of State of North Carolina with regard to workplace safety.

C. The contractor shall keep the surface over and along the trenches and other excavation in a safe and satisfactory condition during the progress of the work.

PART 2 - PRODUCTS

2.1 EXCAVATION CLASSIFICATION

A. All excavation material shall be classified as Undercut (Classified) Excavation, Unclassified Earth Excavation, or Rock.

2.2 SOIL MATERIALS

2.2.1. MATERIAL CLASSIFICATION (ONSITE NATIVE SOILS)

A. Material, meeting the criteria specified in paragraphs B and C below, may be used for:

1) Roadway embankment

2) Roadway subgrade

B. **Satisfactory Soils:** ASTM D2487 soil classification group (Unified Soil Classification System) GC, SM, SC, ML, CL, CH and MH or a combination of these group symbols. However CH and MH are permitted provided the soils have a Liquid Limit (LL) of ≤ 60 and a Plasticity Index (PI) of ≤ 30. Soils shall be free of rock or gravel larger than 3 inches in any dimension, debris, organic matter, waste, frozen materials, muck, roots, vegetation, and other deleterious matter.

C. **Unsatisfactory soils:** ASTM D2487 soil classification group (Unified Soil Classification System) CH and MH soils having a LL of > 60 and a PI of > 30, OH, OL, and PT; soils which contain rock or gravel larger than 3 inches in any dimension, debris, organic matter, waste frozen materials, vegetation, and other deleterious matter. Unsatisfactory soils also include satisfactory soils not maintained within +/- 3% of optimum moisture content at time of compaction, unless otherwise approved by the Town's Engineer.

2.2.2. SELECT MATERIAL CLASSIFICATION (BORROW):

1) Select borrow material may be specified for use in:

a. Embankment

b. Subgrade

c. Backfill in undercut

d. Foundation conditioning

e. Slope and shoulder embankment

f. Material placement over fabric

B. **Select Material Classifications (NCDOT Classes):** Refer to Section 1016 *Select Material* of the NCDOT *Standard Specifications for Roads and Structures* for definitions/classifications of Select Material Classes I through VI.

C. **Offsite Borrow:**

1) If sufficient satisfactory soil material is not available from onsite excavations, provide borrow material.

2) **Offsite Select Borrow for Structural Fill and Embankment:** Materials shall consist of approved NCDOT Class I, II or III material.

3) See paragraph 1.4.A *Borrow* for the definition of borrow.

D. **Crushed Stone Screenings:** Material shall meet the requirements of Section 1016 of the NCDOT *Standard Specifications for Roads and Structures*, Class II, Type 1.

E. **Sand:** Material shall meet the requirements of Section 1016 of the NCDOT Standard Specifications for Roads and Structures, Class II (USCS group SW or SP) material.

2.2.3. TOPSOIL:

A. Topsoil meeting the definition prescribed in paragraph 1.4.N Topsoil obtained either from on-site or an off-site source.

2.3 GEOTEXTILE FABRIC:

2.3.1. Geotextile fabric shall be protected from mud, dirt, dust, sunlight, and debris during transport and storage. Material shall be inert to commonly encountered chemicals; resistant to mildew, rot, insects, and rodents; and biologically and thermally stable. Geotextile fabric for subsurface installation shall not be exposed to direct sunlight for more than 24 hours before or during installation. All geo-fabric to be used within the right-of-way of a Town street must be approved by the Town's Engineer.

A. **Filter Fabric for Rip Rap:** Filter Fabric for Rip Rap and Rip Rap Beddings shall conform to Section 1056 – *Engineering Fabrics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 2 engineering fabric.

B. **Soil Stabilization Fabric:** Generally, soil stabilization fabric shall conform to the requirements of Section 1056 – *Engineering Fabrics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 4 engineering fabric. However, provide fabric meeting Geotechnical Engineers recommendations for the application and use intended.

C. **Fabric for Subsurface Drains:** Non-woven needle-punched fabric shall conform to Section 1056 – *Engineering Fabrics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 1 engineering fabric.

D. **Silt Fence Fabric:** Refer to NCDENR, Division of Energy, Mineral and Land Resources Land Quality Section's *North Carolina Erosion and Sedimentation Control Planning and Design Manual,* latest revision.

PART 3 - EXECUTION

3.1 PREPARATION

3.1.1. GENERAL REQUIREMENTS APPLYING TO ALL AREAS

A. **Construction Staking**: Unless called for otherwise in the proposal or Special Conditions, the contractor is to provide and pay for construction staking in his proposal.

When required to establish either horizontal or vertical alignment, all construction staking is to be provided by the Contractor using the services of a Licensed

Professional Surveyor familiar with construction staking procedures. The cost shall cover all staking required. The Town of Wake Forest is not to be assessed or charged for re-staking costs where damage has occurred to stakes by the Contractor or his Subcontractor or any other agency or person since the project is the responsibility of the Contractor during construction until all applicable site and utility construction has been accepted by the Town of Wake Forest.

The Surveyor will not be responsible for quantity verification. The Town's Engineer or his representative will verify quantities with the Contractor for all work in this contract prior to each billing period. The Town of Wake Forest will accept field measurements by a N.C. Licensed Professional Surveyor for undercut and rock excavation computations.

The drawings may indicate both existing grade and finished grade required for construction of project. Stake out improvements to their established elevations as called for on the plans. Perform other layout work that may be required to construct the facilities.

B. Erosion Control: Where total disturbance exceeds 1/2-acre, no clearing, grubbing or excavation is to begin until an approved soil erosion and sedimentation permit has been secured and posted on site. Once a permit has been approved and a preconstruction conference has been conducted, the contractor/developer is to adhere to the approved erosion and sedimentation control plan and shall be responsible for containing sediment entirely on the project site. All costs for erosion control measure installation, maintenance, removal and final stabilization shall rest with the contractor/developer.

C. Contractor shall plan construction to avoid or minimize disturbance to properties adjacent to the road right-of-way or easement.

D. Access and/or Haul Roads: Any grading or excavation required for equipment travel during the course of construction as well as erosion control, access or haul road removal, restoration, seeding and ground cover shall be provided by the Contractor.

E. The Contractor shall be responsible for damage to areas or items designated by the Town's Engineer to be protected. Repairs to, replacement of, or reparations for areas or items damaged shall be made to the satisfaction of the Town's Engineer and affected property owners before acceptance of the completed project.

F. The Contractor shall protect all buildings or structures located along the roadway or easement.

G. Any fences or mailboxes disturbed by the Contractor shall be repaired to a condition equal to or better than their original condition or to the satisfaction of the Town's Engineer. This may require the use of new material.

H. Contractor shall obtain written permission from property owners for use of any access other than ones located within public rights-of-way or easements. Written permission shall contain conditions for use and restoration agreements between property owner and Contractor.

I. All areas disturbed shall be restored to a condition equal to or better than their original condition and shall be graded to drain.

3.1.2. CONSTRUCTION LIMITS

A. Contractor shall not disturb any areas outside the permitted limits of disturbance contained in this section without express written permission from the Town's Engineer.

B. The Town's Engineer reserves the right to limit the width of land to be disturbed and to designate on the drawings or in the field certain areas or items within this width to be protected from damage.

C. **Specific requirements applying to developed subdivision/lots:**

1) Unless directed otherwise by the Town's Engineer, all trees, shrubs, hedges, or other ornamental plantings located outside of the construction limits, easements, or public rights-of-way shall be protected by the Contractor. The Town's Engineer reserves the right to designate certain trees located within the construction limits for protection where deemed desirable.

2) The contractor shall protect all reasonable septic systems or springs located outside the construction limits.

3) Excavated or blasted rock shall be removed from the site unless otherwise ordered by the Town's Engineer.

D. **Specific requirements applying to undeveloped areas:**

1) In wooded areas, the clearing shall be limited to the easement or right-of-way limits unless indicated differently on the Town of Wake Forest approved construction drawings, in which case, the work shall be confined to the limits defined on the plans. All permanent easements and rights-of-way shall be fully cleared as determined by the Town's Engineer. The Town's Engineer reserves the right to designate certain trees located within the construction limits for protection where deemed desirable.

2) In areas where livestock and pets are kept, the Contractor shall notify property owner prior to commencing work and keep owner advised of progress of work. Fences shall be kept secure at all times and livestock and pets protected from open ditches, machinery, blasting, and other hazards.

3.1.3. PROTECTION OF EXISTING UTILITIES AND UNDERGROUND STRUCTURES

A. Protection of Existing Facilities. Maintain existing utility lines (either overhead or underground), sidewalks, structures, pavement indicated on drawings, or mentioned in specifications, free of damage. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition. Notify Owner utility of any utility damage at once so that emergency measures may be taken to repair the utility. All repairs to utilities damaged by the contractor shall be made by and paid for by Contractor.

B. See paragraphs 3.1.3.A through 3.1.3.F of specification section 02210 *Trenching, Backfilling and Compaction of Utilities.*

3.1.4. PROCEDURES FOR REPAIRING DAMAGED UTILITY SERVICES

A. See paragraphs 3.1.4.A through 3.1.4.C of specification section 02210 *Trenching, Backfilling and Compaction of Utilities.*

3.1.5. PROTECTION OF SURFACE FEATURES

A. Protect structures, above ground utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, sediment deposition, project related sink holes, and other hazards created by operations under this or other related sections.

B. Whenever the work is planned to occur either on or near an existing paved street, the Contractor shall provide pads or take necessary precautions to protect the pavement from damage by the construction equipment. Pavement damaged by cleated or tracked equipment, or by any other means, shall be repaired by the Contractor at his expense to the satisfaction of the Town's Engineer.

C. Provide full access to public and private premises, to fire hydrants, at street crossings, sidewalks and other points as designated by the Town's Engineer to prevent serious interruption of travel.

D. Prevent damage or injury to any fences, surface structures, etc, on or adjacent to the site of the work.

E. Protect and maintain benchmarks, right-of-way or property monuments, or other established points and reference points, and if disturbed or destroyed, items shall be replaced by a Licensed Professional Surveyor to the full satisfaction of the Town's Engineer and/or the jurisdictional agency.

F. See paragraph 1.10, Coordination regarding traffic signals.

3.1.6. PROTECTION OF PERSONS AND PROPERTY

A. Barricade open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or with public access.

B. The contactor shall not enter upon private property for any purpose without first obtaining permission.

C. Contractor shall protect carefully from disturbance or damage all land monuments and property markers until an authorized agent has witnessed or otherwise referenced their locations, and shall not remove them until directed.

D. The Contractor shall be responsible for all damage or injury to property of any character resulting from any act, omission, neglect, or misconduct in his manner or method of executing said work, from his non-execution of work, or from defective work or materials, and he shall not be released from said responsibility until the work shall have been completed and accepted.

E. The Contractor shall, at his own expense, sustain in their places and protect from direct or indirect injury all pipes, poles, conduits, walls, roadways, buildings, and other structures, utilities and property in the vicinity of his work. Such sustaining and supporting shall be carefully done by the Contractor and as required by the Company or party owning the structures or Agency controlling it. The Contractor shall take all

risks attending the presence or proximity of pipes, poles, conduits, walls, thereof and any costs associated will be deducted from any monies due the Contractor. Failure of the Town's Engineer or his/her authorized representative to direct the correction of unsafe conditions or practices shall not relieve the Contractor of his responsibility hereunder.

F. When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, the contractor shall restore such property, at his own expense, to a condition equal to or better than that existing before such damage or injury was done. The contractor shall make good such damage or injury in an acceptable manner by repairing, rebuilding or otherwise restoring as directed.

3.2 CLEARING AND GRUBBING

A. **The work includes but is not necessarily limited to:**

1) Establishing Clearing Limits

2) Protecting Existing Features. The work shall include the preservation from injury or defacement of all vegetation or objects designated to remain.

3) Clearing and grubbing

4) Salvage

5) Stockpiling topsoil and stockpile maintenance

6) Disposal of Waste Materials

7) Restoration

B. **Timbering:**

1) A preconstruction meeting shall be held with appropriate urban forestry personnel (as may be applicable) and the Town prior to any clearing, if required. The Town's Engineer may require tree protection fencing in sensitive areas, where specifically identified trees are desired to be protected, and when required by the landscape ordinance. See also UDO Chapter 8, Tree Protection, Buffers and Landscaping for other requirements.

2) **Establish Limits of Clearing**: Prior to clearing the site, the Contractor shall advise his surveyor to establish the clearing limits. Flagging, clearly delineating the limits, shall designate clearing limits. The limits of clearing street rights-of-way shall be the full right of way as a minimum but shall also extend to the toe of either the cut or fill slope when such point extends outside or beyond the right-of-way line.

3) **Clearing Easements**: Unless directed otherwise on the plans, clearing limits shall extend to the easement line or right-of-way.

4) Trees and shrubs that are to remain within the construction limits will be indicated on the drawings or conspicuously marked on site. Unless otherwise

noted, trees within the construction limits shall become the property of the Contractor and shall be removed from the site.

5) See paragraph 3.1.2 Construction Limits.

C. **Protect existing surface and subsurface features:**

1) **Protection Devices**: The Contractor shall provide barricades, fences, coverings, or other types of protection necessary to prevent damage to existing improvements, not indicated to be removed, and improvements on adjoining property. Trees and shrubs that are to remain within the construction limits will be indicated on the drawings or conspicuously marked on site.

1) **Restoration of damaged items**: Restore any items damaged during construction of the project to their original condition, as acceptable to the Town's Engineer or other authorities having jurisdiction over the item damaged. See also paragraph

2) **Tree Protection**:

a. **Barrier Protection**: Protect existing trees and other vegetation indicated to remain against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary fences barricades or guards as required to protect trees and vegetation to be left standing. See Figures 5.1 and 5.2 (Landscape Design & Installation) for tree and shrub protection. *Extremely damaged trees, which could* eventually *die as a result of the damage, as determined by the Town's Engineer, may be required to be removed at the contractor's expense.*

b. **Abraded or scuffed trees**: Trees that are scraped, scuffed or otherwise abraded by the contractor during the construction process, shall have the damaged area of the tree painted with an approved tree paint to protect the tree from insects. See Figure 5.4 (Landscape Design & Installation).

c. **Watering Plants**: Water trees and other vegetation, which is to remain within limits of construction, as required to maintain their health during period of construction operation.

d. **Root Protection**: Provide protection for roots over 1-1/2 inch diameter that is cut during construction operations. Coat cut faces with emulsified asphalt, or other acceptable coating, especially formulated for horticultural use on cut or damaged plant tissues. Temporarily cover all exposed roots with wet burlap to prevent roots from drying out; provide earth cover as soon as possible.

e. Repairing or replacing trees and vegetation damaged by construction operations shall be done at no additional expense to the Town of Wake Forest.

D. **Clearing and Grubbing Site:**

1) The method of stripping, clearing, and grubbing the site shall be at the discretion of the Contractor.

2) **Clearing Site**: Clear site as defined in paragraph a, below. Remove such items offsite at Contractor's expense.

   a. Clearing Definition: See paragraph 1.4.C, Clearing.

   b. Marginal Areas: In marginal areas, with the Town's Engineer's permission, remove trees where the following conditions exist.

      i) Root Cutting: When clearing up to the "clearing limits," the Contractor shall also remove any tree which is deemed marginal such that when the roots are cut a tree could be rendered unstable by the affects of high winds and thus in danger of toppling into either the right-of-way or onto private property.

      ii) Slender Bending Trees: Where young, tall, thin trees are left unsupported by the clearing operation, and are likely to bend over into the right-of-way, the Contractor, during the clearing operation, shall selectively remove those trees which are located outside and adjacent to the clearing limits and Town right-of-way or easement as well. During the course of construction and during the one-year warranty period, the Contractor shall remove such young trees that overhang into the right-of-way or cleared area. Removal outside of a public right-of-way or easement requires permission from a private property owner. Coordinate owner contact with the Town's inspector.

   c. Trimming trees and roots: Carefully and cleanly cut roots and branches of trees indicated to be left standing, where such roots and branches obstruct new construction.

3) Grubbing:

   a. Grubbing Definition: See paragraph 1.4.H, Grubbing.

   b. The area within the limits of construction or as designated shall be grubbed of all trees, stumps, roots, brush, undergrowth, hedges, heavy growth of grasses or weeds, debris and rubbish of any nature that, in the opinion of the Town's Engineer, is unsuitable for foundation material.

   c. Grubbing under areas to be paved and foundations: Completely remove stumps, root mats, buried logs, and other debris protruding through ground surface in their entirety. Such removal shall be made within 5 feet of areas to be paved or structure foundation limits and to a depth of not less than 2 feet below the finished surface of the pavement, unless otherwise directed by the Town's Engineer. Use only hand methods for grubbing inside drip line of trees indicated to be left standing.

   d. Nonperishable items that are not deleterious to the project and will be a minimum of 5 feet below the finished elevation of the earthwork or slope of the embankment may be left in place with the approval of the Town's Engineer.

4) Depressions: To prevent standing/ponding water, fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further

excavation or earthwork is indicated. Place fill material in horizontal layers not exceeding 6 inches loose depth, and thoroughly compact to a density equal to adjacent original ground.

E. **Repair of Damaged Vegetation:** If damaged by construction operations, trees and vegetation designated to remain shall be repaired or replaced at Contractor's expense in a manner acceptable to the Town's Engineer. When such damage does occur, and the damage does not necessitate vegetation replacement, all rough edges of scarred areas shall be removed and the area repaired in accordance with accepted horticultural practices. The Town's Engineer may require that the tree and/or vegetation damage be repaired as directed by a qualified tree surgeon.

F. **Topsoil Stripping and Stockpiling:**

1) Topsoil Stripping Defined: Topsoil stripping is defined as organic surface soil found in a depth of not less than 6 inches. For a definition of topsoil, see paragraph 1.4.N Topsoil.

2) Stripping: Strip topsoil to whatever depths encountered, and in such manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.

3) Remove the existing topsoil to a depth of 6 inches or to the depth encountered from all areas in which excavation will occur. The topsoil shall either be stored in stockpiles separate from the excavated trench material if the topsoil is to be respread or otherwise disposed of off-site. Topsoil stockpiles shall be graded to freely drain surface water, and shall have a silt fence placed around the base of the stockpile.

4) Tree Protection: Where trees are indicated to be left standing, stop topsoil stripping a sufficient distance from such trees to prevent damage to main root systems.

5) **Stockpile Maintenance**: Maintain stockpiles and excavations in such a manner as to prevent inconvenience or damage to an existing or proposed structure located either on the project site or on adjoining property. Avoid surcharge or excavation procedures, which can result in heaving, caving or slides.

6) **Stockpiling**: Stockpile topsoil in areas either indicated on the plans or at locations that will not interfere with construction and which have been approved by the Town's Engineer. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent wind-blown dust. Construct adequate and approved silt fences or other devices to prevent off site deposits of soil to streams etc.

7) **Cost**: The cost of stripping is to include all costs for equipment, personnel, stockpiling of material, segregation of topsoil from undesirable material, disposal of undesirable or unusable waste or demolition material, re-spreading of topsoil if applicable, erosion control, dust control, temporary seeding, etc. The cost of rock removal by blasting or other mechanical means (except ripping) is not to be included in the stripping cost.

G. **Disposal:**

1) Debris from the site shall be removed in such a manner as to prevent spillage. Keep pavement and area adjacent to site clean and free from mud, dirt, dust, and debris at all times.

2) All brush, tree tops, stumps, slash, and debris shall be hauled away from site or otherwise disposed of in a manner acceptable to the Town's Engineer. The contactor shall clean up debris resulting from clearing operations continuously with the progress of the work and remove promptly all salvageable material that becomes his property. Such material is not to be reused in construction. Sale of material at or on the site is prohibited.

3) Stumps of trees cut down outside of the excavation area will be removed. Perishable material shall not be disposed of at the construction site.

4) **Waste Disposal**: Remove all material of whatever nature, including but not limited to demolition material, pipe, rock, brick, concrete, asphalt, clay, silt, gravel, hard pan, etc. as directed by Town's Engineer and dispose of unsuitable material in either a NCDENR permitted demolition land fill and/or a site which legally can accept earthen fill (i.e. meeting all applicable laws such as erosion control, zoning, etc.). Material, of a compactible nature, which can be re-used as borrow, shall be replaced and re-compacted to the requirements set forth in these specifications. Burning or burying, as a means of waste disposal, is not permitted.

5) Unless removed from site for chipping/shredding and recycling, brush, laps, roots, and stumps from trees shall be disposed of in a NCDENR approved and permitted land clearing and inert debris type landfill. Disposal of cleared material shall be in accordance with all local and state laws.

6) **Burning:** Contact Tow of Wake Forest Inspections, Office of Fire Inspections. No burning of clearing debris may take place within 1000 feet of a residence. The burning shall be performed on days when the wind is still and not expected to pick up within 24 hours. No burning shall take place on days the US Forestry Service has issued a no burn warning. Prior to beginning the clearing operation, the contractor shall secure a burning permit.

7) The Contractor will be responsible for obtaining all applicable permits and paying all fees for the disposal of excess material.

3.3 UNCLASSIFIED EXCAVATION, UNDERCUTTING, BORROW, EMBANKMENT:

3.3.1. CONSTRUCTION METHODS

A. **Excavation/Protection of Grade**: Excavation shall be performed as indicated on the plans or as directed by the Town's Engineer to the lines, grades, and elevations, and shall be finished to a reasonable smooth and uniform surface. Do not leave depressions or bowls where water can pond. Maintain ditches and drains to provide drainage at all times on the project. Protect graded areas against action of elements prior to acceptance of work. Re-establish grade where settlement or erosion occurs. During the process of excavation, the grade shall be maintained and surface shall be shaped and rolled so that it will be well drained at all times.

When solid rock is incurred in the excavation, the rock shall be removed to a minimum depth of 6 inches below the surface of the subgrade or as directed by the Town's Engineer.

All soft and yielding material, boulders, loose stones, or any other unsuitable materials in the subgrade which will not readily compact shall be removed and replaced with suitable material which shall then be thoroughly compacted. Material unsatisfactory for subgrade foundation shall be removed to a depth specified to provide a satisfactory foundation. The portion so excavated shall be refilled with suitable material obtained from the grading operations or borrow area and thoroughly compacted by rolling. The Town's Engineer must approve material obtained from on site grading operation.

No rock, stone, or rock fragments, larger than 3 inches in their greatest dimension will be permitted in the top 12 inches of the subgrade. No rock, stone, or rock fragments larger than 8 inches in their greatest dimension will be permitted in the remainder of the fill.

For areas that do not require fill, scarify and compact to a depth of 6 inches.

B. Any manipulation, aeration, and recompaction of suitable materials necessary to obtain the required density shall be considered as incidental to the construction operations, and shall be performed by the Contractor at no additional cost to the Town.

C. Any portion of the subgrade inaccessible to the roller or rolling equipment shall be thoroughly compacted with hand or mechanical tampers.

3.3.2. UNCLASSIFIED EXCAVATION

A. Scope: The work includes all operations in connection with unclassified excavation, borrow, construction of fills and embankments, rough grading, and disposal of excess materials in connection with the preparation of the project site for construction of the proposed facilities. Unclassified excavation shall include the removal of all earth, concrete, curb and gutter, pavement, rippable rock, hardpan and other materials as may be necessary or called for on the drawings and outlined in these specifications.

All material from excavation, which is considered suitable for re-use by the Town's Engineer, shall be used as embankment fill wherever fill is needed or required. The Contractor shall arrange his work so that the usage of suitable "compactable" excavated material will be possible. Surplus earthen material from unclassified or undercut excavation shall be disposed of offsite at the Contractor's expense.

B. Prior to beginning grading or embankment operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with these specifications.

C. Should the Contractor, through negligence or other fault, excavate below the designated grades, he shall replace the excavation with approved satisfactory materials, in an approved method, at his own expense. All material determined unsatisfactory shall be disposed of in waste areas as directed. Topsoil shall not be used in embankments but shall be handled and placed as directed.

D. The Contractor shall satisfy himself as to the character, quantity, and distribution of all materials to be excavated. No payment will be made for any excavated material that is used for purposes other than those designated.

3.3.3. UNDERCUT (CLASSIFIED) EXCAVATION

A. **Undercut (Classified) Excavation:** See paragraph 1.4.Q for definition and compensation for undercut (Classified Excavation).

B. **Soft subgrade:** If after excavation to subgrade, the material is found to be soft, spongy or unfit for use as subgrade, the unsuitable material shall be removed as directed by the Geotechnical Engineer and the subgrade shall be brought to proper elevation by filling with suitable select borrow placed and densified as directed by the Town's Engineer.

C. **Stabilization of Soft subgrade with stone:** Where improvement of subgrade is proposed to be stabilized using crushed stone, stabilize subgrade with granular materials as directed by the Geotechnical Engineer.

D. **Stabilization of soft subgrade with Geotextile:** Where improvement of a soft subgrade is determined to be made by employing a synthetic geotextile, the proposed method of construction, minimum density requirements and material specifications shall be provided by a Geotechnical Engineer for review and approval prior to ordering material. Stabilization of soft subgrade with Geotextile shall also meet the requirements of paragraphs 2.3.1.B – *Soil Stabilization Fabric* and paragraph 3.10 – *Placement of Soil Stabilization Fabric*.

E. **De-Watering:** Where groundwater is expected to be encountered during excavation, provide de-watering system necessary to successfully complete compaction and construction requirements, to prevent softening and disturbance of subgrade below foundations and fill material, and to allow foundations and fill material to be placed in the dry, and to maintain a stable excavation side slope. Employ de-watering specialist for selecting and operating de-watering system. Keep de-watering system in operation until dead load of structure exceeds possible buoyant uplift force on structure. Dispose of groundwater to an area that will not interfere with construction operations or damage existing construction. Install groundwater-monitoring wells as necessary. Slowly shut off de-watering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.

De-watering is considered incidental to the cost of excavation.

3.3.4. EMBANKMENTS/STRUCTURAL FILL

A. **General:** Where existing grades require the use of on-site embankment or structural fill to reach the required section elevation, the Contractor shall deposit suitable approved material from excavated areas. Embankments shall be made of satisfactory soil material free from debris, roots, trash, stones, or other harmful substances, and shall be placed in successive horizontal layers of loose material not more than 8-inches in loose depth for the full width of the cross sections. Each layer shall be spread uniformly and rolled with a mechanical compactor unit suitable for the type soil being densified until the soil is thoroughly compacted in accordance with Table 2200.1A and Table 2200.1B of this specification.

B. **Evaluation of Subgrade:** Prior to placement of compacted fill, the Town's Engineer or his representative shall carefully inspect the exposed subgrade. Any topsoil, organic material still in place, any material that is frozen, wet, soft, loose and/or otherwise undesirable shall be removed and disposed. Afterwards, the Contractor shall proof roll the exposed subgrade, in the presence of the Town's Engineer or his representative. The inspection shall include, but not be limited to, proofrolling the prepared subgrade with a rubber-tired fully loaded dump truck that has a minimum gross weight of at least 20,000 pounds (10 tons) under the observation of a representative of the Town. Any unsuitable materials thus exposed shall be removed and replaced with select material as approved by the Geotechnical Engineer. Provide the necessary amount of select fill compacted to the density requirements outlined in Table 2200.1A and Table 2200.1B of this specification. If a bridging lift is required, consult with Town's Engineer for directions before proceeding with placement of bridging lift.

Fill material shall not be placed on frozen ground or areas covered with ice and/or snow or areas with a moisture content above optimum.

C. **Preparation of Ground Surface for Embankments or Fills:** Before fill is placed, scarify existing grade to a minimum depth of 6 inches. In areas where the existing or proposed ground surface is steeper than one vertical to four horizontal (4:1), plow surface in a manner to bench and break up surface so that fill material will bind with the existing surface.

D. **Embankment/Fill Construction**:

1) **Typical Section Controls**: Construct embankments and fills at the elevations and grades indicated on the plans. Where indicated by typical cross-section on plans, the completed fill shall correspond to the shape of the typical cross section regardless of the method used to show the shape, size, and extent of line and grade of completed work.

2) For the type of material being used, compact material by sheepsfoot rollers, pneumatic rollers, vibratory rollers, or by other applicable and suitable equipment as required to obtain the specified density outlined in Table 2200.1A and Table 2200.1B of this specification. Control moisture for each layer as necessary to meet requirements of compaction.

3) **Failure of Compactive Efforts**: See paragraph 3.5.E Failure of Compactive Efforts.

E. **Moisture Control:** Moisture shall be controlled during filling and compaction stages to minimize the chances of failure and degradation of either the soil or subgrade. The material entering the embankment in each of the layers shall be within a tolerance of plus or minus +/- 20% of the optimum moisture content before rolling to obtain the prescribed density. Wetting or drying of the material and manipulation when necessary to secure uniform moisture content throughout the layer shall be required. Should the material be too wet to permit proper compaction or rolling, all work on the embankment shall be delayed until the material has dried to the required moisture content. If high moisture is due to negligence of Contractor due to improper drainage, the Town's Engineer may require removal and replacement of material.

F. **Wet weather excavation/filling:** Construction operations shall not take place during periods of rain, unless the excavated material and/or the fill site is adequately protected from moisture, to prevent excessive moisture build-up in loose soils rendering an otherwise acceptable soil or subgrade unusable. Such carelessness unnecessarily increases construction costs.

G. **Filling on or over existing Road beds:** When any portion of the embankment is to be constructed over an old road bed or parking lot, with the approval of a Geotechnical Engineer, the existing surface shall be scarified and manipulated as directed by the Geotechnical Engineer.

H. **Protection of graded surfaces:** During their construction, embankments and/or fills shall be maintained at all times to prevent an accumulation of ponding or standing water.

3.3.5. BORROW (OFF-SITE/ON-SITE)

A. **General:** Provide the necessary quantities of specified, approved materials for subgrade, structural fill and/or embankment compacted to a density equaling or exceeding that specified in Table 2200.1A and Table 2200.1B. Unless otherwise designated on the plans and contract documents, the Contractor shall make his own arrangements for obtaining select fill material for borrow and pay all costs involved. Include costs for excavation, loading, hauling, placement, spreading and compaction of select borrow material in original proposal as bid, whether lump sum or unit price. All material shall be approved prior to placement or shall otherwise meet the following paragraph (paragraph 3.3.5.B, *Use of On-Site Excavation As Borrow)*.

B. **Use Of On-Site Excavation As Borrow:** On-site excavation, which is suitable for use as structural fill/borrow in either embankments and/or roadway fill (for areas that have either been undercut or are to be filled), shall be used first. Unless otherwise provided for in the proposal, unclassified excavation suitable to be used as "on-site borrow" (which is excavated from within a 2,500 foot radius of its destination) shall not be paid for as *borrow* but is considered to be incidental to the cost of *unclassified excavation*. Placement of this material shall include all costs associated with placement, spreading, grading and compaction of the material. If the Contractor places more borrow than is required, and thereby cause a waste of excavation, the amount of such waste, unless authorized, will not be included for payment.

3.3.6. PREPARATION OF AREAS TO RECEIVE ASPHALT PAVEMENT OR CONCRETE:

A. All soft and yielding material, boulders, loose stones, or any other unsuitable materials encountered in the subgrade which will not readily compact shall be removed and replaced with suitable material which shall then be thoroughly compacted. All roots, stumps, and other perishable matter encountered in the preparation of the subgrade shall be removed to a depth of not less than 2 feet below the finished surface of the pavement, unless otherwise directed by the Engineer.

B. Ensure rock has been removed to a depth of 6 inches below subgrade or as directed by the Town's Engineer.

C. Areas to be paved: After all excavation, undercutting, and backfilling has been completed, the subgrade shall be properly shaped and thoroughly compacted. The area of the highest degree of compactive effort shall include all areas beneath

pavement and curb and gutter and shall extend at least a minimum of one-foot behind the back of the curb. Compaction shall be in accordance with Table 2200.1A. If the subgrade does not contain sufficient moisture for compaction, it shall be wetted as directed by the Engineer.

D. Any portion of the subgrade inaccessible to the roller or rolling equipment shall be thoroughly compacted with hand or mechanical tampers.

E. The Contractor shall then proofroll the exposed subgrade, in the presence of the Town's Engineer or his representative. The inspection shall include, but shall not be limited to, proof rolling the prepared subgrade with a rubber-tired fully loaded dump truck that has a minimum gross weight of at least 20,000 pounds (10 Tons). Proof rolling shall be performed in lengths of not less than one block as measured from center of intersection to center of intersection, from center of intersection to end of cul-de-sac, or 750 linear feet. Any unsatisfactory materials thus exposed shall be removed and replaced with satisfactory select material as approved by the Town's Engineer. Provide the necessary amount of select fill compacted to the density requirements outlined in this specification.

   Areas that rut or pump excessively under the wheels of the proof-roller shall be repaired by the developer before the street is paved. Should the developer disagree with the representative of the Town about the need for repairs to the subgrade, the developer or his project engineer may hire a Licensed Professional Engineer to perform CBR tests on the prepared subgrade. If the Engineer certifies that the full width and length of the subgrade will provide adequate support for the design pavement section and the anticipated loading for the design life of the paved area, the area may be paved without making repairs to the subgrade.

F. Curb and gutter: The subgrade shall be constructed true to grade and cross section as may be shown on the drawings or standard details. All roots, stumps, and other perishable matter encountered at the subgrade shall be removed to a depth of not less than 12 inches below the subgrade. Where such material is encountered, it shall be removed by undercutting, the area filled with select material and compacted. All rock shall be cleared to a depth of 4 inches below the subgrade or as directed by The Town's Engineer.

   Excavation to an elevation slightly above finished subgrade shall be completed prior to setting of forms. The subgrade shall be maintained in a smooth, compacted condition, in conformity with the required section and established grade until the concrete is in place. The subgrade shall be wet down sufficiently in advance of the placing of the concrete to ensure a firm and moist condition.

   All subgrade shall be graded and protected to prevent an accumulation of standing water, and consequent subgrade saturation, in the event of rain.

   In cold weather, the subgrade shall be so treated, protected, and prepared as to produce a satisfactory subgrade entirely free from frost when the concrete is deposited.

   Compaction shall be in accordance with Table 02200.1A.

G. **Sidewalks and driveway areas:** The subgrade shall be constructed true to grade and cross section as may be shown on the drawings or standard details. In areas where

sidewalks or driveways are to be poured, the following conditions will be observed relating to compaction of the subgrade:

1) Where good firm material (original material, not borrow) has been carefully graded, so that no undercutting has occurred, this material shall be considered acceptable subgrade, upon approval by the Town's Engineer.

2) Where fill material has been placed, where undercutting has occurred, or where loose or unsuitable material is encountered, such fill or loose material shall be compacted as required by Table 2200.1A, as applicable.

3) Where roots, stumps, or other perishable matter is encountered at the subgrade, they shall be removed to a depth of 4 inches below the subgrade and such undercuts shall be treated as specified in the preceding paragraph.

All subgrade shall be graded and protected as to prevent an accumulation or standing water, and consequent subgrade saturation, in the event of rain.

In cold weather, the subgrade shall be so treated, protected, and prepared as to produce and provide a satisfactory subgrade entirely free from frost when the concrete is deposited.

H. **Grading tolerances of finished surfaces**: Earthwork shall conform to the lines, grades, and typical cross sections shown on the plans, standard details, or as established by the Town's Engineer. Changes in grade shall be accomplished by smooth curves.

1) Shape subgrade under pavement and curb and gutter to within ½ inch of required subgrade elevations.

2) Finish pavement and curb and gutter to within ¼ inch of required finish elevations.

3) Shape subgrade under sidewalks to within 0.10 foot of required subgrade elevations.

4) Finish sidewalks to within 0.10 foot of required finish elevations.

5) For all other areas, subgrade and finish elevations shall be within 0.10 foot of required corresponding elevations.

3.3.7. BACKFILL OF CURB AND GUTTER AND SIDEWALKS:

A. Immediately after the removal of forms for curb and gutter, sidewalks and driveways, the space between the back of the curb, sidewalks, and driveways shall be backfilled and smoothed off in a manner to prevent the accumulation of standing water.

3.3.8. FINISHING SLOPES AND SURFACES

A. **Surfacing:** The surface of all areas of earth and other materials shall be finished to a reasonable smooth and compact surface substantially in accordance with the surface lines, cross sections, and elevations or standard details indicated, on the drawings, or

as established by the Town's Engineer in this manual. Changes in grade shall be accomplished by smooth parabolic curves

3.4 STRUCTURES: EXCAVATION AND BACKFILLING

A. **General**

1) General: See Section 02210 - *Trenching, Backfilling, and Compaction of Utilities* for excavation and backfilling for structures (manholes, catch basins, etc.).

2) Work includes, but is not necessarily limited to, excavation for structures, head/endwalls, and retaining walls, removal of underground obstructions and undesirable material, backfilling, filling, and fill, backfill, and subgrade compaction.

3) Obtain fill and/or backfill material necessary to produce grades required. Materials and source to be approved by either a Geotechnical Engineer or the Town's Engineer. Excavated material, approved by Town's Engineer, may also be used for fill and backfill.

4) In following paragraphs of this section of specifications, the word *"foundations"* includes footings, base slabs, foundation walls, mat foundations, pile caps, grade beams, piers and any other support placed directly on soil.

B. **Requirements for Structures.**

1) The following requirements shall not supersede the applicable requirements of the latest edition of the NC State Building Code.

2) **General**. Do not commence excavation for foundations for structures until the density and moisture content of proposed fill material meets requirements of this specification section.

3) Excavate to elevations and dimensions indicated or specified on the plans. Allow additional space as required for construction operations, shoring, and inspection of foundation(s), sheeting and laying back trench to conform to OSHA guidelines.

4) **Excavation**: Removal of obstructions and undesirable materials in excavation includes, but is not necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade soils, expansive type soils, any other materials which may be concealed beneath present grade, as required to execute work indicated on drawings. If undesirable material and obstructions are encountered during excavation, remove material and replace as directed by Town's Engineer or Geotechnical Engineer.

5) **De-watering**. See paragraph 3.3.3.E, De-Watering.

6) **Subgrade preparation**: Level off bottoms of excavations to receive foundations, floor slabs, support pads, or compacted fill. Remove loose materials and bring excavations into approved condition to receive concrete or fill material. Where compacted fill material must be placed to bring subgrade elevation up to underside of construction, scarify existing subgrade upon which fill material is to be placed to a depth of 6 inches and then compact to density stated in this section

of specifications before fill material can be placed thereon. Do not carry excavations lower than shown on plans for foundations except as directed by Geotechnical Engineer. If any part of excavation is carried below the required subgrade depth without authorization, fill from excavated level to subgrade elevation with either concrete of same strength as required for superimposed foundation or crushed stone as directed by Town's Engineer or Geotechnical Engineer. No extra compensation will be made for over-excavation.

7) **Subgrade Stabilization**: If the subgrade under foundations, fill material, floor slabs on grade, or support pads becomes frozen, loose, wet, or soft before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved consolidated crushed stone or as otherwise directed by either the Geotechnical Engineer or Town's Engineer.

8) **Bedding Requirements for Structures**: See specification Section 02210 *Trenching, Backfilling and Compaction of Utilities,* paragraph 3.5.6.G *Cushioning for Structures* for bedding requirements.

9) **Inspections**: Notify the Town's Engineer as soon as excavations are completed in order that subgrade may be inspected. Either a Geotechnical Engineer or the Town's Engineer is to inspect and approve subgrade under compacted fill material, under foundations, under floor slabs-on-grade, under support pads and under retaining wall footings. Subgrade is to be inspected and passed as to being free of undesirable material, being of compaction density required by this specifications, and being capable of supporting superimposed foundation, fill, and loads to be placed thereon. Inspections shall also be made before fill is placed, concrete is poured, formwork is erected, or reinforcing steel is placed. The Geotechnical Engineer or the Town's Engineer shall be given the opportunity to inspect the subgrade both prior to and after subgrade compaction. When a Geotechnical Engineer is employed, he is to notify the Town in writing, with copies sent to Owner and Contractor, that subgrade has been inspected and approved and state what corrective actions were taken, if any, to bring subgrade into an approved condition.

10) **Slab construction**: Do not place floor slabs on grade, including equipment support pads, until subgrade has been approved, piping has been tested and approved, reinforcement placement has been provided, and Contractor receives approval to commence slab construction. Do not place floor slabs on grade, including equipment support pads, when temperature of air surrounding the slab and pads is expected to be below 40 degrees F.

11) **Protection of Structure**: Prevent new and existing structures from becoming damaged due to construction operations or other reasons. Prevent subgrade under new and existing foundations from becoming wet and undermined during construction due to presence of surface water or due to construction operations.

12) **Shoring**: See specification Section 02210 *Trenching, Backfilling and Compaction of Utilities,* paragraph 3.5.3, *Trench Protection: Trench Shaping, Bracing & Shoring* for shoring requirements.

13) **Drainage**: Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging structures. Maintain excavations where foundations, floor slabs, equipment support pads or fill

material are to be placed free of water. Provide pumping required to keep excavated spaces clear of water during construction. Should any water be encountered in the excavation, notify Town's Engineer. Provide free discharge of water by trenches, wells, well points, or other means as necessary and drain to point of disposal.

14) **Frost Protection**: Do not place foundations, slabs on grade, footings, support pads, or fill material on frozen ground. When freezing temperatures may be expected, do not excavate to full depth indicated, unless foundations, floor slabs, equipment support pads, or fill material can be placed immediately after excavation has been completed and approved. Protect excavation from frost if placing of concrete or fill is delayed.

15) **Heat Protection**. Do not place concrete on a dry hot subgrade. Sprinkle the base to moisten the subgrade but do not soak.

C. **Backfilling *inside* of structures: (below foundations, footings, base slabs, floor slabs and equipment support pads):**

1) Fill and Backfill Placement – General (excludes footings):

a. Before placing structural fill, all subgrades are to be free of undesirable material, scarified to a depth of 6 inches and re-compacted to the density specified in Table 2200.1B.

b. Prior to placing fill and backfill material, optimum moisture and maximum density properties for proposed fill material shall known.

c. Place fill and backfill material in thin lifts, 6-inches maximum, consistent with the compaction requirements noted above in Table 2200.1B or as directed by a Geotechnical Engineer.

d. Compact material by means of equipment of sufficient size and type that can provide specified density within allowable moisture tolerances. Use hand operated equipment for filling and backfilling next to walls (*see also paragraph 3.4.E and paragraph 3.4.F below for additional requirements regarding backfilling against walls*).

e. Do not place fill and backfill when subgrade to receive fill and backfill material is frozen, wet, loose, or soft.

f. Use vibratory equipment to compact granular material. Do not use water without permission of either a Geotechnical Engineer or the Town's Engineer.

2) **Footing Subgrade**: Footing subgrade may be stepped but not by more than 12 inches per step or sloped at more than 2 percent longitudinally. When subgrade soils or of a granular nature, or when directed by the Town's Engineer, pre-compact subgrade with hand vibratory equipment. Such soils tend to be "fluffed-up" as result of excavation operation. Do not place any fill or backfill material until subgrade has been inspected and approved by either a Geotechnical Engineer or the Town's Engineer as being free of undesirable material and, if applicable, verified to have been compacted to the specified density.

3) **Borrow source**: Select borrow material and source shall be approved by Town's Engineer before material is placed. Fill and backfill shall be select structural fill, sand or crushed stone as applicable to the condition and which meets the classification noted in paragraph 2.2.2.B & 2.2.2.C Select Material Classification (Borrow).

4) **Granular Fill Under Floor Slabs-on-Grade**: Place all floor slabs on grade on a minimum of 4" of # 57 or # 67 Stone. Compact granular fill to 75 percent relative density as determined by ASTM D4253. See paragraph 2.2.2.C Select Material Classification (Borrow).

5) **Vapor Barrier**: Unless called for otherwise on the plans, install a continuous 6-mil vapor barrier under floor slabs on grade as shown on drawings.

D. **Backfilling *Outside* of Structures:**

1) **Application of this section**: This paragraph of these specifications applies to fill and backfill placed outside of structures above the bottom level of both foundations and piping but not under paving. Provide either native compactable fill or structural fill material meeting paragraph 3 of this specification.

2) **Fill and Backfill Placement**:

a. Place fill and backfill material in thin lifts consistent with compaction requirements.

b. Compact material with equipment of proper type and size to obtain density specified within allowable moisture tolerances. Use only hand operated equipment for filling and backfilling next to walls and retaining walls.

c. Do not place fill or backfill material when subgrade to receive material is frozen, wet, loose, or soft.

d. Use vibratory equipment for compacting granular material. Do not use water unless permission is granted by either a Geotechnical Engineer or the Town's Engineer.

E. **Zone of Influence around structural walls/retaining walls:**

1) Where fill is required outside the exterior limits of foundations, there is a minimum *zone of influence* where the compactive effort would adversely affect the structure without precautions. In that zone, extra care shall be taken to protect or otherwise prevent damage to a structural wall. The *zone of influence* of the compactive effort shall be considered to be, around perimeter of structure, the greater of the following horizontal distances:

a. The depth of the fill needed bring the existing grade up to the proposed finished grade, or

b. A distance equal to depth of compacted fill measured from the bottom of the footing to the proposed finished surface grade.

2) In the *zone of* influence, follow the procedures outlined in paragraph F below.

F. **Backfilling Against Structural Walls.**

1) **General**: Unless a Civil/Structural Engineer or the Town's Engineer allows otherwise, do not backfill and compact around any part of structures until each part has reached its specified 28 day compressive strength and backfill material has been approved. (Higher early-strength concrete may be used to reduce this time if approved by either a Civil/Structural Engineer or the Town's Engineer, but at no additional cost to the Owner).

2) **Preparatory to backfilling**: Do not start backfilling until concrete forms have been removed, trash removed from excavations, pointing of masonry work and concrete finishing.

3) **Restrained walls**: For walls which are restrained by floors at the top and/or bottom, do not place fill against walls until:

a. The walls have reached their 28-day required compressive strength, and

b. Either the floor slabs at top and bottom of walls are in place, or

c. The walls are braced.

4) **Free standing walls**: For free standing walls, do not place fill against walls until:

a. The walls have reached their 28-day required compressive strength, or

b. The walls are braced.

5) **Unbalanced pressures**: To prevent unbalanced pressures, bring backfill and fill up uniformly around the structures and individual walls, piers, or columns.

3.5 COMPACTION: SUBGRADE PREPARATION AND COMPACTION REQUIREMENTS

A. Preparation: See paragraph 3.3.6 *Preparation of Areas to Receive Asphalt Pavement and Concrete*.

B. **Confirmation of Initial Geotechnical Report/Design Assumptions** (*for roadway projects to be turned over to the Town*): Prior to placement of stone base over the subgrade, the Geotechnical Engineer or his representative shall confirm the initial test results and design assumptions by visual classification and hand augur borings. If the visual findings are at variance with the initial testing and design assumptions, recommendations for modifications to the subgrade shall be provided to the designer, the Grading Contractor, and the Town's Engineer. The Town's Engineer shall approve the proposed recommendations prior to incorporation of the measures. See Table 2200.3.

C. **Minimum Compaction Requirements:** Compaction percentages are percentages of maximum dry density as determined by indicated ASTM Standards. Unless noted otherwise on drawings or more stringently by other sections of these specifications, place and ensure degree of compaction of embankment and borrow materials does not fall below the following percentages of the maximum density at optimum moisture content.

D. Passing Test: Average of 3 test results meeting the applicable provisions of tables 2200.1A and 2200.1B (below) with no one test failing by more than -2 percentage points. Moisture content tolerance is to be within +/- 2 percentage points of the optimum moisture content unless otherwise specified by the Town's Engineer or Geotechnical Engineer.

Table 2200.1A		
Minimum Compaction Limits		
Location	**Density**	
Site and Public Roadways		
Embankment/borrow under roadway pavement surfaces, sidewalks, and curb and gutter	Top 12 inches	98% of the maximum dry density by ASTM D698 (Standard Proctor), AASHTO T99.
	Up to within 12 inches	95% of the maximum dry density by ASTM D698 (Standard Proctor), AASHTO T99.
Stone Base (other than NCDOT and parking lots)	95% of the maximum dry density by ASTM D698 (Standard Proctor), AASHTO T99.	
Roadway Shoulders	95% of the maximum dry density by ASTM D698 (Standard Proctor), AASHTO T99.	
Under turf, sodded, planted, or seeded non-traffic areas	85% of the maximum dry density by ASTM D698 (Standard Proctor), AASHTO T99.	
Pavement Patches over pipe	95% of the maximum dry density by ASTM D698 (Standard Proctor), AASHTO T99. See also Standard Detail 9.53, Table 2	
Under and Around Piping	See Standard Detail 9.53, Table 2	

Table 2200.1B		
Location	**Density**	
Building Structures		
Embankment/borrow beneath and within 5 feet of buildings, under foundations, and scarified existing subgrade beneath buildings.	Top 12 inches	100% of the maximum dry density by ASTM D698 (Standard Proctor)
	Up to within 12 inches	95% of the maximum dry density by ASTM D698 (Standard Proctor)
Outside structures next to walls and any other structural exterior member	90% of the maximum dry density by ASTM D698 (Standard Proctor)	
Backfill less than 10 feet from exterior	90% of the maximum dry density by ASTM D698 (Standard Proctor)	

Table 2200.1B	
Location	**Density**
Building Structures	
retaining walls	

E. Failure of compactive efforts: If compaction efforts should fail to provide a stable subgrade in accordance with the requirements in paragraph 3.5.D, Passing Test after subgrade materials have been shaped and brought to optimum moisture, such unstable materials shall be removed to the extent directed by the Geotechnical Engineer and/or the Town's Engineer and replaced and compacted using new material and must pass compaction test prior to proceeding to the next stage of construction and at no expense to the Town.

The costs associated with excavation and re-compaction of areas that have failed will be the Contractors responsibility.

F. **Compaction Lifts:**

Table 2200.2	
Compaction Lift Thickness of	
Lift Thickness (inches)	**Location**
6	Inside street rights-of-way
12	Outside street rights-of-way

G. **In-place testing of soils shall be tested based on the following:**

Table 2200.3	
In-Place Density Tests	
Soil Type/Classification	**Reference Standard**
GW, GP, GM, GC, SW, SP	• Sand Cone Method (ASTM D1556) • Nuclear Method ASTM D2922) [by percentage of Standard Proctor Density according to ASTM D 698]
SM, SC, ML, CL	• Sand Cone Method (ASTM D1556) • Rubber Balloon Method (ASTM D2167) • Nuclear Method ASTM D2922) • Drive-Tube Method (ASTM D2937) [by percentage of Standard Proctor Density according to ASTM D 698]

H. **Field Testing Limitations:**

1) When field density testing is incorporated according to Table 2200.1A and Table 2200.1B, subgrade adequacy is to be confirmed by proof rolling in the presence of the Town's Engineer or his representative. In-place field density testing of the street or pad subgrade will not be required.

2) In-place field density tests of the roadway or pad subgrade in cut sections (excavation) is not required.

3) Testing/adequacy of intermittent undercut areas and repair areas (e.g. around manholes and boxes) that have been backfilled with select fill and compacted will be confirmed by proof rolling.

3.6 TESTING: SUBGRADE COMPACTION TESTING AND CONTROL

A. **Testing**

Testing of embankment/borrow shall be performed by an independent laboratory approved by the Town and the Contractor. The Contractor shall be responsible for excavation for testing if required.

B. **Quality Assurance vs. Quality Control:**

Quality Assurance (QA) testing, and the associated cost, is the responsibility of the Town. Quality Assurance testing by the Town is used to confirm that the Contractor is generally performing his/her work in compliance with these specifications.

Quality Control (QC) testing is the necessary and required testing that is to be performed by the Contractor (or Developer) to assure that he/she is meeting and complying with the requirements of these specifications. The developer shall employ a Geotechnical Engineer firm to perform the testing. The associated cost for QC testing is the Contractor's (or Developer's) responsibility. The Contractor (or Developer) is also responsible for all costs associated with corrective work as well as any "re-testing" costs incurred by the Town when the Town's tests (tests for Quality Assurance) results in a "failure" to meet the minimum specified compaction requirements. Provide copies of the tests reports to the Town for verification and record.

Quality Control (QC) testing for Town funded projects: For municipal projects, the Town will employ and compensate a Geotechnical Engineering firm to provide soils testing and inspection services.

A. **Quality Assurance (QA):**

In the course of placement of embankment fill/borrow or in utility trench backfill, the Town's Engineer may require additional "Field Density Determinations" or compaction tests. Such tests will be at the Town's expense. When compaction tests are called for by the Town, the Town's Engineer will determine the location of the tests and the Town shall engage a qualified testing firm to perform the test. A representative of the Town will observe tests and a copy of the test results and inspection report will be submitted by the testing firm directly to the Town's Engineer. When the tests indicate that the density failed to meet the requirements of Tables 2200.1A and 2200.1B the Contractor shall comply with paragraph 3.5.E, *Failure of Compactive Efforts*.

Payment for failed QA density tests: For Town funded projects, payment for failed in-place density tests shall be made by the Contractor by deducting the testing cost from the forthcoming retainage. For other projects in which the Town will ultimately

assume ownership and maintenance, the testing costs for failed in-place density tests shall be billed directly to the Contractor.

C. **Quality Control (QC):** The Contractor shall perform in-field density tests in accordance with Table 2200.4, below. Inspection reports shall be submitted by the testing firm directly to the Town's Engineer. See paragraph 3.5.D, *Passing Test*.

1) All test results shall be provided to the Town's Engineer as they become available from the testing agency.

2) All Projects: In the absence of a pre-construction Geotechnical investigation, the Geotechnical testing firm is to perform laboratory tests (ASTM D698, Standard Proctor) to establish a moisture-density relationship for all materials that are proposed to be used as fill. Where borrow is proposed to be used from an NCDOT certified pit, the contractor may forgo this requirement provided copies of the test reports are furnished to the Town.

3) Contractor shall give a 24-hour notice to Geotechnical testing firm for subgrade testing, subgrade confirmation, or inspections.

4) **Minimum Compaction Testing Frequency**:

The following testing frequency shall be employed on both Town funded projects and projects proposed to be turned over to the Town for maintenance and/or ownership.

Table 2200.4	
Testing Frequency	
Location	**Frequency**
Buildings and structures	1 test group[a] for every 5,000 square feet
Road	1 test group[a] for every 300 feet of road
Parking Lots	1 test group[a] for every 10,000 square feet
Unpaved areas	1 test group[a] for every 20,000 square feet
Pipe Trenches in Roadways	See Table 2210.2 of Specification Section 02210
Proof Roll	Entire surface area to be paved
Exception: Where additional tests are required to determine the extent of unacceptable compaction (having been determined by the initial QA/QC test).	

[a]One test group consists of compaction tests on each layer of fill and backfill material.

D. **Site access for testing**: Ensure Town, at all times, has immediate access to the site for the testing of all soils related work. Ensure excavations are in a safe condition for testing personnel.

3.7 BLASTING: EXCAVATION BY BLASTING/USE OF EXPLOSIVES

3.7.1. BLASTING:

Contact the Town of Wake Forest inspections department.

3.7.2. DISPOSAL OF ROCK

Excavated rock shall be hauled off the site at the Contractor's expense. Borrow required to replace excavated rock shall be provided by the Contractor and shall be included in the unit price bid for rock excavation. No blast rock refuse or boulders shall be used as backfill in any part of the site unless otherwise approved by the Town's Engineer. Where rock has scattered over adjoining property as a result of blasting, the Contractor shall remove the rock and restore the area to its original condition at no cost to the Town.

3.7.3. PAYMENT

Mass rock excavation shall be paid for by the cubic yard of material removed. No payment shall be made for "over-excavation." The volume removed shall be determined by cross-sectioning both the "pre-blast" and "post-blast" surfaces and determining the volume between the two by the average-end-method. See paragraph 1.4.I, *Rock in Open Excavation* for Rock definition.

3.8 METHOD OF VOLUME MEASUREMENT

A. **Method of Measurement**

Contractors are required to furnish accurate counts of all excavation and/or fill moved which is to be paid for under a unit price Contract. The volumes shall be measured by either truck count or cross-section, whichever method is approved by the Town's Engineer or stated in the proposal and/or bid documents. When a truck count is used, the Town's Engineer or his representative shall verify the count independently or employ one of the other following methods verify and account for volumes.

1) Tally Method:

Excavation: When unclassified excavation or undercut volumes are to be counted by the *truck tally method*, "**swell**" is to be incorporated into the truck volume in the amount of 15%. Unless otherwise agreed to or justified by a Geotechnical Engineer, the following pay volumes are to be used for either unclassified or undercut excavation:

Tandem:	13 CY
Tri-axle:	15 CY

Borrow: When either off-site or on-site borrow is to be counted by the truck tally method, "shrinkage" is to be incorporated into the truck volume (shrinkage of truck volume placed compared to compacted fill volume) utilizing the following pay volumes:

Tandem:	10 CY
Tri-axle:	12 CY

Loading Truck: A qualified truck load is one that is loaded up to within approximately 6" of the top of the dump bed, prior to dumping.

2) Average-End-Method:

Excavation and fill can be computed using the average-end-method. When used, this method is to be employed using the existing contours shown on the Contract

Drawings and the Contractors actual surveyed finished contours (surveyed by a licensed Surveyor). In so doing, the finished contours are to be plotted at the same scale as the original drawing and a transparency furnished to the Engineer for comparison to design grades. The volume computations are also to be submitted along with the Surveyor's seal and a certification as to the volumes measured.

The Contractor, at his discretion and with the prior approval of the Engineer, may survey the "stripped" site (the site after topsoil has been removed) and compute the volumes based on the stripped site and the "designed" finished grade as shown on the Contract Drawings. As before, a transparency to the same scale and the Surveyors computations and certification are to be submitted to the Engineer for comparison and verification.

3) **Volume Formulas**:

Unless otherwise approved, the following formulas are to be used in computing cut and fill:

Fill Formula

Net Fill = Raw Fill Vol. – Unclassified X (1 - Shrink Factor) + Strip Vol. - Undercut Fill placed in Fill Slopes X (1 - Shrink Factor) - Pavement Section or Building Floor Pad

Cut Formula

Net Cut = Raw Cut - Strip Vol. + Pavement Section or Building Floor Pad

4) Wasting of excess excavation, undercut or topsoil as fill

As a standard practice, it will be assumed that all undesirable material, such as undercut excavation, excess topsoil or unclassified excavation, is to be placed in roadway fill slopes wherever possible as long as approved by the Town's Engineer. However, in no case shall such material be placed inside the zone of structural influence of buildings, roadways or roadway structures.

On Town projects, with permission of the Town's Engineer and subject to the rules governing solid waste material regulated by NCDENR, undercut excavation and excess topsoil or unclassified excavation may to be placed in roadway fill slopes and landscape berms before having to haul the material off-site. Off-site wasting of such material is to be a last resort.

Stumps shall not to be wasted in roadway fill slopes or on other public works projects or easements without the written permission of the Town's Engineer.

In site computations, unless approved otherwise by the Engineer, these undesirable volumes are to be counted as "fill" up to the volume reasonably possible for such use on the site adjusted for shrinkage.

5) **Fill, in terms of volume, defined:** Fill is defined as a compacted post-construction volume in-place.

3.9 RIP RAP AND RIP RAP BEDDING PLACEMENT

Placement of Rip Rap and Rip Rap Bedding shall conform to Section 876 – *Rip Rap* of the *NCDOT Standard Specifications for Roadways and Structures*, latest revision.

3.10 PLACEMENT OF SOIL STABILIZATION FABRIC

Placement of soil stabilization fabric shall conform to the requirements of Section 270 – *Fabric for Soil Stabilization* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision and in accordance with the recommendations and directions of the Town's Engineer and/or a Geotechnical Engineer for the application and use intended.

3.11 SUBSURFACE DRAINAGE SYSTEMS

See Section 2630 – *Storm Drainage* and Section 02210 – *Trenching, Backfilling, and Compaction of Utilities* for both materials and construction requirements regarding subsurface drainage systems.

3.12 DUST CONTROL

The Contractor shall control dust throughout the life of the project within the project area and at all other areas affected by the construction of the project, including, but not specifically limited to, unpaved roads, haul roads, access roads, disposal sites, borrow and materials sources and production sites. Dust control shall not the considered effective where the amount of dust creates a potential or actual unsafe condition, public nuisance, or condition endangering the value, utility, or appearance of any property.

The Contractor shall be required to sprinkle with water or to apply dust-allaying materials. Dust control is considered incidental and shall be carried out at the Contractor's expense.

3.13 CLEANUP AND RESTORATION OF SITE

A. During the progress of the work, the Contractor shall keep the premises and the vicinity of the work clear from unsightly and disorderly piles of debris. Suitable locations shall be specified for the various construction materials and for debris. The materials shall be kept in their storage locations, except as needed for the work and debris shall be promptly and regularly collected and deposited in the specified location.

B. Upon completion of grading operations, the Contractor shall fine grade the site, removing all surplus excavated material, leaving the area free from surface irregularities. He shall dispose of all surplus material, dirt, and rubbish from the site and shall keep the site free of mud and dust to the satisfaction of the Town's Engineer. The Contractor may be required to sprinkle the street to prevent dust nuisance and/or sweep the street to remove mud or debris.

C. When working on the shoulders of paved roads, the Contractor shall keep the pavement clean of all loose earth, dust, mud, gravel, etc., and shall restore roadway shoulders and ditches as required by either the NCDOT or the right-of-way owner.

D. After all work is completed, the Contractor shall remove all tools and other equipment, leaving the site free, clean, and in good condition.

E. The Contractor shall keep the surface over and along the roadways and other graded areas in a safe and satisfactory condition during the progress of the work.

F. No area shall be disturbed until an Erosion Control Permit has been obtained and a preconstruction conference conducted. Once the site has been stabilized, the Contractor shall remove all erosion control measures and stabilize disturbed areas as required by the approved plans/permit.

G. Work is only to be performed within a dedicated easement or right-of-way. No disturbance of private property shall be permitted without first obtaining written permission from the property owner.

3.14 SALVAGE OF USEABLE MATERIALS

All materials such as iron castings, paving blocks, brick, pipe and etc., removed during excavation that is useable on this project shall be used after approval of its use by the Town's Engineer or the applicable owner of the street right-of-way. Such material shall be stockpiled on site. Unnecessary abuse and damage to these items shall be the Contractors responsibility and the cost of replacement may be deducted from the retainage.

End of Section 02200

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02210 - TRENCHING, BACKFILLING AND COMPACTION OF UTILITIES

(Last revised 3/09/15)

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

Part 1- General
Part 2 – Products
Part 3 – Execution
Backfilling Trenches
Bedding for Structures
Bedding for Pipe
Blasting
Classified Excavation - Def
Cleanup & Restoration
Clearing and Grubbing
Common Trench Backfill-Def
Common Trench Backfill-Install
Compaction Requirements
Dewatering
Erosion Control, NPDES
Foundation Preparation
Flowable Fill Concrete
Geotextile Separation Fabric
Minimum Pipe Cover
Pavement Repair
Rip Rap Placement
Rock Excavation (Trench)
Select Earth Backfill-Def
Select Earth Backfill-Install
Shoring
Subdrain Construction
Testing Requirements
Trenching
Trench Backfill Material
Trench Material Classification
Unclassified Trench Excavation
Undercut

PART 1 - GENERAL

1.1 GENERAL

A. The Contractor shall furnish all labor, materials, tools, equipment, and perform all work and services necessary for or incidental to the furnishing and installation, complete, of all operations in connection with excavation, trenching, and backfilling of underground utilities as shown on drawings and as specified, in accordance with provisions of the Contract Documents, and completely coordinated with work of all other trades.

B. Work included in the project consists of, but is not limited to, methods of installation of the following:

1) Storm drainage pipe

2) Relocation of existing pipe

3) Surface drainage conduit/pipe

C. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, complete and compatible installation.

1.2 RELATED DOCUMENTS

A. Section 02700 – Storm Drainage

B. NCDENR Division of Energy, Mineral and Land Resources, Land Quality Section's *North Carolina Erosion and Sedimentation Control Planning and Design Manual*.

C. OSHA *Standard 29 CFR Part 1910.109*, NCDOT Rules for Transporting Explosives, and local Fire Department Regulations with regard to blasting.

D. OSHA Standard 29 CFR Part 1926, "Safety and Health Regulations for Construction," Subpart P "Excavations," Standard Number 1926.650, latest revision.

1.3 SUMMARY

A. This section includes:

1) Excavating and backfilling trenches for buried water, sewer, storm drainage, buried utility structures, and appurtenances.

2) Preparing subgrade for buried water and sewer, buried utility structures, and appurtenances.

B. Construction and materials related to this section but covered elsewhere:

1) Erosion Control: North Carolina Sediment Control Law.

1.4 DEFINITIONS

For the purposes of this specification, the following definitions refer to storm drainage systems that come under the authority of the Town of Wake Forest as specified within this section and other sections of this Manual.

A. **Backfill:** Soil materials used to fill an excavated trench.

1) **Initial Backfill** (Carefully Compacted Select Earth Backfill): Backfill placed beside and up to 12 inches above the top of the pipe in a trench, including haunches to support sides of pipe.

2) **Final Backfill** (Common Trench Backfill): Backfill placed over the initial backfill to fill a trench.

In terms of volume, backfill is defined as a compacted post-construction volume in-place.

B. **Bedding Course:** Layer of loosely placed select backfill material meeting NCDOT Class II, Type 1 (washed or unwashed crushed stone screenings) or Class III, Type 1 (NCDOT 2S or 2MS fine aggregate). See Standard Detail 9.53 for visual description of bedding (layer B1).

C. **Borrow:** Borrow shall consist of approved fill material imported from off-site.

D. **Town Engineer:** The Town Engineer or his/her designated representative.

E. **Town:** Refers to the Town of Wake Forest.

F. **Classified Excavation (undercut):** Classified excavation shall consist of the removal and satisfactory disposal of all unsuitable material located below subgrade elevation. Where excavation to the finished grade section results in a subgrade or slopes of muck, peat, matted roots, etc., the Contractor shall remove such material below the

grade shown on the plans or as directed; and areas so excavated shall be backfilled with approved select fill or stone as ordered by the Town's Engineer. See also paragraph U, Unclassified Excavation.

G. **Clearing:** Clearing shall consist in the felling, cutting up, and satisfactory disposal of trees and other vegetation designated for removal in accordance with these specifications.

H. **Competent Person**: Competent Person means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

I. **Contractor:** Refers to a Contractor licensed in the State of North Carolina to perform public utility construction.

J. **Easement:** A grant of one or more of the property rights by the property owner for limited use of private land for a public or quasi-public purpose and within which the owner of the property shall not erect any permanent structures except when authorized by the Town. Ownership of the land remains with the second party.

K. **Foundation Stone:** Clean well-graded stone, authorized by the Town's Engineer, used to strengthen and/or provide support to an otherwise weak subgrade. Foundation stone is placed and the subgrade improved before bedding stone is placed. Where voids may cause migration of native or backfill material, use well graded material without voids (coarse sands; [Unified Soil Classification System] SC, SM). See Standard Detail 9.53 for visual description of Foundation stone (layer "B2").

L. **Grubbing:** Grubbing shall consist of the removal of roots 3 inch and larger, organic matter, debris and stumps and the disposal thereof.

M. **Haunching:** Layer of clean coarse stone placed and compacted up to the springline of the pipe. Where voids may cause migration of native or backfill material, use well graded material without voids (coarse sands; [Unified Soils Classification System] SC, SM). See Standard Detail 9.53 for visual description.

N. **Rock Excavation for Trenches and Pits:** Rock excavation for trenches and pits includes removal and disposal off-site of materials and obstructions encountered that cannot be practically excavated with a track-mounted power excavator equivalent to a Caterpillar Model No. 325 or equivalent equipped with new rock teeth. Practical excavation is defined as the ability to remove at least 30 cubic yards during one hour of continuous digging. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as open excavation.

O. **Rock in Open Excavation:** All boulder, solid ledges, bedded deposits, unstratified masses, and conglomerations of material so firmly cemented as to possess the characteristics of solid rock. Rock in open excavations includes removal and disposal on-site of materials and obstructions encountered in general excavation other than trenches and pits that cannot be dislodged and excavated with modern, track-mounted, heavy-duty excavating equipment without drilling, blasting, or ripping. Rock is defined as material which cannot be effectively excavated during general grading with a D-8 or equivalent dozer drawing a new single-tooth ripper. Effective excavation is defined as the ability to remove 10 cubic yards or more of material after

one hour of continuous ripping. Typical of materials classified as Rock in Open Excavation are boulders larger than 1-1/2 cubic yards or more in volume, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits.

P. **Shall:** Means a mandatory requirement.

Q. **Structures**: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

R. **Subgrade:** Surface or elevation remaining after completing the trench excavation or, the top surface of a backfill (stone or soil) immediately below the pipe conduit or pipe bedding, as applicable.

S. **Topsoil:** A native, imported, or modified soil which is primarily organic in nature, free of rocks, clumps of clayey soils and otherwise friable in texture.

T. **Trench Borrow:** Trench borrow shall consist of approved material imported from off-site for use as fill or backfill required to be placed in trenches either as initial carefully controlled select backfill or final common trench backfill. Trench borrow shall not be used until all suitable trench excavation material has been placed in the trench, unless authorized by the Town's Engineer. Unless otherwise designated on the plans and in the contract documents, the Contractor shall make his own arrangements for obtaining borrow and pay all costs involved.

U. **Unclassified Excavation:** Removal and disposal of any and all material above subgrade elevation, except solid rock and undercut excavation, located within the limits of construction. See also paragraph F, Classified Excavation.

V. The following are industry abbreviation for various pipe materials:

1) **CAP**: Corrugated Aluminum Pipe

2) **PCP**: Plain Concrete Pipe

3) **RCP**: Reinforced Concrete Pipe.

1.5 SUBMITTALS

A. Submit respective pipe or conduit manufacturer's data regarding methods of installation, jointing and general recommendations.

B. Submit product data and a sample of drainage fabric or separation fabric and fully document each with specific location or stationing information, date, and other pertinent information.

C. Submit test reports and fully document each with specific location or stationing information, date and other pertinent information.

1) See paragraph 1.6.A below regarding Geotechnical Testing Agency Qualifications.

2) **Material Test Reports**: Provide from a qualified testing agency which either indicate or interpret test results for compliance of the following requirements indicated:

a. Classification according ASTM D2487 of each select on-site or borrow soil proposed for backfill, unless otherwise directed by Town's Engineer.

b. Laboratory compaction curve according to ASTM D698 for each select on-site or borrow soil material proposed for backfill.

D. **Blasting:**

1) Contract the Town of Wake Forest Inspections Department.

E. **Product Data:**

1) Each type of plastic warning tape

2) Stabilization/Separation fabric

3) Drainage Fabric

1.6 QUALITY ASSURANCE

A. **Geotechnical Testing Agency Qualifications:** An independent testing agency qualified according to ASTM E329 to conduct soil materials and rock-definition testing as documented according to ASTM D3740 and ASTM E548. Testing Lab to be AMRL (AASHTO Materials Reference Laboratory) and CCRL (Cement and Concrete Reference Laboratory) certified.

The testing laboratory shall be approved by the Town's Engineer and will be responsible for conducting and interpreting tests. The testing laboratory shall state in each report whether or not the test specimens conform to all requirements of the Contract Documents and specifically note any deviation.

Specific test and inspection requirements shall be as specified herein.

B. Comply with all codes, laws, ordinances, and regulations of governmental authorities having jurisdiction over this part of the work.

C. The Contractor shall comply with applicable requirements of NCDENR Division of Energy, Mineral and Land Resources, *North Carolina Erosion and Sedimentation Control Planning and Design Manual*, latest revisions.

D. Comply with applicable requirements of NFPA 495, *Explosive Materials Code,* latest revisions.

1.7 QUALITY STANDARDS

A. For convenience, reference is made in succeeding paragraphs to specific portions of various standards. Also, modifications and additions are made. Neither the reference nor the modifications are intended to de-emphasize any other portion of the standards.

B. It is the intent of this specification that whenever a procedure or technique is not called out herein, that the industry standard, as represented by ACI, ASTM or other appropriate recommendation, shall be used.

C. Materials and operations shall comply with the latest revision of the Codes and Standards listed below:

American Society for Testing and Materials

ASTM C33	Concrete Aggregates
ASTM D698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3) (Standard Proctor)
ASTM D1556	Standard Method of Test for Density of Soil in Place by the Sand-Cone Method
ASTM D1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (Modified Proctor)
ASTM D2049	Standard Method of Test for Relative Density of Cohesionless Soils
ASTM D2167	Standard Method of Test for Density of Soil in Place by the Rubber-Balloon Method
ASTM D2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D3740	Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
ASTM D4254	Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
ASTM D4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
ASTM E329	Standard Specification for Agencies Engaged in Construction Inspection and/or Testing
ASTM E548	Standard Guide for General Criteria Used for Evaluating Laboratory Competence

American Association of State Highway & Transportation Officials

AASHTO T99	The Moisture-Density Relations of Soils using a 5.5-pound Rammer and a 12-inch drop.
AASHTO T180	The Moisture Density Relations of Soils using a 10-pound Rammer and an 18-inch drop.
AASHTO M145	The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

D. **Standard Abbreviations:**

AASHTO	American Association of State Highway Transportation Officials.
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
ANSI	American National Standards Institute
AREA	American Railway Engineers Association
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
FS	Federal Specifications
MSDS	Material Safety Data Sheets
NCDENR	NC Department of Environment and Natural Resources
NCDOT	North Carolina Department of Transportation
NCMA	National Concrete Masonry Association
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Administration
USACOE	United States Army Corps of Engineers

1.8 PROJECT CONDITIONS

A. **Demolition:** Demolish and completely remove from the site existing underground utilities indicated on the plans to be removed. Coordinate with applicable utility companies to shut off services if other active utility lines are involved.

B. **Environmental - Wetlands:** Before crossing or entering into any jurisdictional wetlands, contractor shall verify whether or not a wetlands permit has been obtained for the encroachment and whether special restrictions have been imposed in that permit. Care shall be taken to prevent draining or otherwise destroying non-permitted wetlands. Restore as stated on either the project drawings, the contract

documents, and/or as noted in the permit. All crossings, disturbances, and encroachments into wetlands shall be subject to US Army COE and NC Division of Water Resources Water Quality Permitting Section approval and permitting requirements and conditions.

C. **Environmental - Buffer Crossing Requirements:** Before crossing streams or ditches, buffers (verify specific buffer), lakes, or rivers, the Contractor shall verify whether either the line is exempt or a permit has been obtained to encroach into a nutrient sensitive river basin buffer and if so, to what extent work is permitted to occur. Unless otherwise permitted, shown on the contract drawings, or exempted by NCDENR or other proper authority, water and sewer crossing stream, river, pond, or lake buffers are to be as near perpendicular as possible (the crossing is considered to be perpendicular if it intersects the stream or surface water between an angle of 75 and 105 degrees). Do not disturb more than 40 linear feet (longitudinal) of riparian buffer. When permitted to encroach into zone 1 (the lower 30 feet beside the stream or water), adhere to all of the following minimum, but not necessarily limited to, Best Management Practices in during construction.

1) Woody vegetation is cleared by hand. No grading allowed.

2) Stumps to remain except in trench where trees are cut. Minimize disturbance to roots in buffer zone.

3) Backfill trench with the excavated soil immediately following installation.

4) Do not use fertilizer except for the one-time application to reestablish vegetation.

5) Minimize removal of woody vegetation, the amount of disturbed area, and the time the disturbed area remains disturbed.

6) Take measures to ensure diffuse flow of water through the buffer after construction.

7) In wetland areas, use mats to minimize soil disturbance.

8) Schedule work in buffers to ensure exposure of denuded surface in the buffer is kept to a minimum.

9) Wells: If buffer distance cannot be obtained at either a public or private water supply well, the well is to be abandoned per the requirements of the Wake County Health Department and NCAC 15A Subchapter 2C, Section .0100, *Well Construction Standards*.

D. **Geotechnical Investigation**

1) Where a Geotechnical report has been provided to the Contractor by the Town, the data on sub-surface soil conditions is not intended as a representation or warranty of the continuity of such conditions between borings or indicated sampling locations. It shall be expressly understood that the Town of Wake Forest will not be responsible for any interpretations or conclusions drawn there from by the Contractor. The data is made available for the convenience of the Contractor.

2) In addition to any report that may be made available to the Contractor, the Contractor is responsible for performing any other soil investigations felt necessary for proper evaluation of the site for the purposes of planning and/or bidding the project, at no additional cost to the Town of Wake Forest.

E. **Protection of pavement**

Debris from the site shall be removed in such a manner as to prevent spillage. Keep pavement and area adjacent to site clean and free from mud, dirt, dust, and debris at all times. Employ the necessary measures required to meet this requirement.

1.9 SERVICE INTERRUPTION

For service interruption, operation of valves, taps, fire hydrant operation, etc, contact the City of Raleigh Public Utilities Operations Division at 919.996.2737 between the hours of 7:30 AM and 4:00 PM. After 4:00 PM, call the after hour's emergency number at 919.829.1930. Provide a minimum of 48 hours notice or desired utility interruption or necessary operation of valves or hydrants.

Refer to the following link regarding service interruption: http://www.raleighnc.gov/home/content/PubUtilAdmin/Articles/WaterandSewerFAQs.html

For any other utility, contact the applicable utility agency.

1.10 COORDINATION

A. The City of Raleigh Public Utilities Department will be the sole operator of all valves and hydrants within the Town of Wake Forest. Coordinate all utility service interruptions with the City of Raleigh Public Utilities Department.

B. Coordinate tie-ins to municipal roadway system with the Town of Wake Forest and to NCDOT roadways with Wake County Division Engineer's office.

C. When traffic signals, loops, or their appurtenances are likely to be damaged or interfere with construction, coordinate temporary operation with the NCDOT and/or the applicable agency having jurisdiction of the signals. Provide a minimum of 1 weeks' notice prior to anticipated disturbance or interruption. At the discretion of the Town's Engineer, the notice may be required to be published in the newspaper.

D. Repair of pavement markings: When cuts are made through any paved surface and the cuts extend through the pavement markings, the replaced pavement shall be marked to match the existing.

E. Benchmark/Monument Protection: Protect and maintain benchmarks, monuments or other established reference points and property corners. If disturbed or destroyed, they must be replaced at Contractor's own expense by a Licensed Professional Surveyor and to the full satisfaction of Owner/Town of Wake Forest.

F. Contact *"NC One Call"* at 811 before digging.

1.11 PUBLIC CONVENIENCE

The contractor shall at all times so conduct his work as to ensure the least possible inconvenience to the general public and the residents in the vicinity of the work. Fire hydrants on or adjacent to the work shall be kept accessible to firefighting equipment at all times. Temporary provisions shall be made by the Contractor to ensure the proper functioning of all gutters, sewer inlets, drainage ditches, and irrigation ditches, which shall not be obstructed except as approved by the Town's Engineer.

Refer to the Town of Wake Forest Noise Ordinance by visiting the following link: http://www.wakeforestnc.gov/residents-noiseordinance.aspx

1.12 TRAFFIC CONTROL

A. When working within any NCDOT System road or highway, conform to the *Manual on Uniform Traffic Control Devices*, latest revision (MUTCD) as well as the NCDOT *Standard Specifications for Roads and Structures*, latest revision.

B. Traffic Maintenance shall comply with the latest revision of the NCDOT *Standard Specifications for Roads and Structures*, Division 9 – *Signing* and Division 11 – *Work Zone Traffic Control*, as well as other applicable sections.

C. A traffic control plan shall be submitted to the Town of Wake Forest Engineering and NCDOT (if applicable) for approval.

D. When traffic signals or their appurtenances are likely to be damaged or interfere with construction, coordinate temporary operation with the NCDOT or the Town's Engineer. Provide a 1 week notice prior to anticipated disturbance or interruption.

E. Whenever it becomes necessary to leave a section of trench open after completion of the day's work, the contractor shall provide barricades and lights to protect the public. Operate warning lights during hours from dusk to dawn each day and as otherwise required for inclement weather and visibility.

1.13 EROSION AND SEDIMENTATION CONTROL AND NPDES MONITORING, CONTROLS, AND LIMITATIONS FOR PERMITTED DISCHARGES

Refer to the Town of Wake Forest UDO for Erosion and Sedimentation Control requirements; Chapter 12.

http://www.wakeforestnc.gov/Data/Sites/1/media/Residents/Planning/development%20services/currentudo.pdf

1.14 SAFETY

A. Ensure full compliance to applicable requirements of OSHA. Refer to 29 CFR 1926 OSHA "Construction Industry Regulations", latest revision.

B. Comply with local requirements and specific requirements of State of North Carolina with regard to workplace safety.

C. The contractor shall keep the surface over and along the trenches and other excavation in a safe and satisfactory condition during the progress of the work.

PART 2 - PRODUCTS

2.1 SOIL, BEDDING AND BACKFILL

2.1.1. TRENCH BACKFILL MATERIAL CLASSIFICATION (NCDOT CLASSES)

A. **Select Earth Backfill for Concrete Pipe:** Select earth backfill shall be free of debris, roots, frozen materials, organic matter, rock, or gravel larger than 1-inch in any dimension, or other harmful matter and shall generally meet NCDOT *Standard Specifications for Roads and Structures*, Section 1016 – *Select Material* for properties and gradation, Class II or III unless otherwise approved by the Town's Engineer. Stone screenings meet the intent of this specification.

B. **Common Trench Backfill:**

1) **Satisfactory Soils**: ASTM D2487 soil classification group (Unified Soil Classification System) GW, GP, GM, SW, SM, SC, ML, and or a combination of these group symbols; free of rock or gravel larger than 3 inches in any dimension, debris, waste frozen materials, vegetation, and other deleterious matter.

2) **Unsatisfactory soils**: ASTM D 2487 soil classification group GC, CH, MH, OH, OL and PT; soils which contain rock or gravel larger than 3 inches in any dimension, debris, waste frozen materials, vegetation, clumps of clay larger than 3 inches in any dimension, and other deleterious matter. Unsatisfactory soils also include satisfactory soils not maintained within +/- 3% of optimum moisture content at time of compaction, unless otherwise approved by the Town's Engineer.

C. When material is to be utilized for backfilling of undercut areas that are excessively wet, the material shall consist of NCDOT Select Material Class II, III or IV.

2.1.2. PIPE BEDDING

A. **Bedding for Reinforced Concrete Storm Drainage Pipe:** See Standard Detail 9.53.

2.1.3. STRUCTURES, BACKFILL AROUND:

A. Backfill shall be approved by the Town's Engineer and shall be free from large or frozen lumps, wood, or rocks more than 3 inches in their greatest dimension or other extraneous material. The top 12 inches are to be free of material greater than 1-inch in their greatest dimension. Porous backfill shall be either #67 or #57 clean stone.

2.1.4. FOUNDATION STONE/TRENCH STABILIZATION:

A. Foundation/Trench Stabilization Material: Select material meeting NCDOT Class V (#78M stone) or Class VI (#57 stone) for foundation conditioning. Encapsulate with engineering fabric as directed by the Engineer using Type 4 soil stabilization fabric (NCDOT Table 1056-1). Overlap all transverse and longitudinal joints in fabric a minimum o f 18 inches.

2.1.5. FLOWABLE FILL CONCRETE BACKFILL

A. **(Controlled Low Strength Material):** Concrete strength shall be liquid enough to flow, be self-leveling, excavatable, and have a minimum 28-day compressive strength

of 30-psi but not more than 100-psi. Non-excavatable flowable fill concrete shall have a minimum 28-day compressive strength of 125-psi but no more than 200-psi (to be excavatable by machine equipment). Materials shall comply with the recommendations within chapter 3 of ACI 229, latest revision, which include cement, aggregates, fly ash, water, admixtures, slag and other non standard materials).

Excavatable is an application where it may be necessary to remove the flowable fill at a later date. Non-excavatable is an application where it is not necessary to remove or otherwise excavate the flowable fill at a later date.

2.2 MISCELLANEOUS

2.2.1. GEOTEXTILE FABRIC

Geotextile fabric shall be protected from mud, dirt, dust, sunlight, and debris during transport and storage. Material shall be inert to commonly encountered chemicals; resistant to mildew, rot, insects, and rodents; and biologically and thermally stable. Geotextile fabric for subsurface installation shall not be exposed to direct sunlight for more than 24 hours before or during installation.

A. **Filter Fabric for Rip Rap:** Filter Fabric for Rip Rap and Rip Rap Beddings shall conform to Section 1056 – *Engineering Fabrics of the NCDOT Standard Specifications for Roadways and Structures*, latest revision for Type 2 engineering fabric.

B. **Soil Stabilization Fabric:** Generally, soil stabilization fabric shall conform to the requirements of Section 1056 – *Engineering Fabrics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 4 engineering fabric. However, provide fabric meeting Geotechnical Engineers recommendations for the application and use intended.

C. **Fabric for Subsurface Drains:** Non-woven needle-punched fabric shall conform to Section 1056 – *Engineering Fabrics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 1 engineering fabric.

D. **Silt Fence Fabric:** Refer to NCDENR, Division of Energy, Mineral and Land Resources Land Quality Section's *North Carolina Erosion and Sedimentation Control Planning and Design Manual,* latest revision.

PART 3 - EXECUTION

3.1 PREPARATION

3.1.1. GENERAL REQUIREMENTS APPLYING TO ALL AREAS

A. Contractor shall plan construction to minimize disturbance to properties adjacent to the storm drain lines.

B. Access and/or Haul Roads: Any grading or excavation required for equipment travel during the course of construction as well as erosion control, access or haul road removal, restoration, seeding and ground cover shall be provided by the Contractor. Refer to the UDO for other related requirements.

C. The Contractor shall be responsible for damage to areas or items designated by the Town's Engineer to be protected. Repairs to, replacement of, or reparations for areas or items damaged shall be made to the satisfaction of the Town's Engineer and affected property owners before acceptance of the completed project.

D. The Contractor shall protect all buildings or structures located along the drainage line, ditch or stream. Hand trenching, shoring, or other methods may be required.

E. Any fences disturbed by the Contractor shall be repaired to a condition equal to or better than their original condition or to the satisfaction of the Town's Engineer. This may require the use of new material.

F. Contractor shall obtain written permission from property owners for use of any access other than ones located within public rights-of-way or easements. Written permission shall contain conditions for use and restoration agreements between property owner and Contractor.

G. All areas disturbed shall be restored to a condition equal to or better than their original condition and shall be graded to drain.

H. The Contractor shall replace or repair all damaged or destroyed hedgerows and property corners using the services of a licensed Professional Surveyor.

3.1.2. CONSTRUCTION LIMITS

A. The Town's Engineer reserves the right to limit the width of land to be disturbed and to designate on the drawings or in the field certain areas or items within this width to be protected from damage.

B. Contractor shall not disturb any areas outside the permitted limits of disturbance contained in this section without express written permission from the Town's Engineer.

C. Contractor shall make select cutting of trees, taking smallest trees first, that are mandatory for the construction of the drainage line or ditch. See UDO for specific guidelines.

D. Should it become necessary to move the position of any underground structure, the Contractor may be required to do such work as directed by the Town's Engineer. Method of payment shall be agreed upon by the Town's Engineer and the Contractor prior to commencing work.

E. If existing utilities are found to interfere with the permanent facilities being constructed under this section, immediately notify the Town's Engineer and secure instructions. Do not proceed with permanent relocation of utilities until instructions are received from the Town's Engineer.

F. The widths measured from the centerline of the storm drainage lines shall be as shown on the contract drawings. The Contractor shall protect all areas outside these construction limits unless written variations are granted by the Town's Engineer.

G. **Specific requirements applying to developed subdivision/lots**

1) Unless directed otherwise by the Town's Engineer, all trees, shrubs, hedges, or other ornamental plantings located outside of the construction limits, easements, or public rights-of-way shall be protected by the Contractor. The Town's Engineer reserves the right to designate certain trees located within the construction limits for protection where deemed desirable.

2) The contractor shall protect all reasonable septic systems or springs located outside the construction limits.

3) Excavated or blasted rock shall be removed from the site unless otherwise directed by the Town's Engineer.

H. **Specific requirements applying to undeveloped areas**

1) In wooded areas, the clearing shall be limited to the easement or right-of-way limits unless indicated differently on the Town of Wake Forest approved construction drawings, in which case, the work shall be confined to the limits defined on the plans. All permanent easements and rights-of-way shall be fully cleared as determined by the Town's Engineer. The Town's Engineer reserves the right to designate certain tree located within the construction limits for protection where deemed desirable.

2) In areas where livestock and pets are kept, the Contractor shall notify property owner prior to commencing work and keep owner advised of progress of work. Fences shall be kept secure at all times and livestock and pets protected from open ditches, machinery, blasting, and other hazards.

3.1.3. PROTECTION OF EXISTING UTILITIES AND UNDERGROUND STRUCTURES

A. **Subsurface obstructions:** Take necessary precautions to protect existing utilities from damage due to any construction activity. The Contractor shall locate existing utilities, culverts, and structures (above or below ground), before any excavation starts and coordinate work with utility companies. The Contractor shall be responsible for notifying utility companies when working within the vicinity of the existing utilities. Omission from or inclusion of located utility items on plans does not constitute non-existent or definite location. Even though for convenience, the utility may be shown on the plans, the Contractor is responsible for and shall call for utility location a minimum of 48 hours prior to excavation. Contact underground damage protection services NC One Call or current locator service. Secure and examine local utility surveyor records for available location data including building service lines. Also, for storm sewer and electric location, call the Town of Wake Forest at 919.435.9570.

B. Unless shown to be removed, protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to trenching. If damaged, repair or replace at no additional cost to the Town. In excavating, care must be taken not to remove or injure any subsurface structure. All existing gas pipes, water pipes, steam pipes, telephone lines, cable TV lines, electrical conduits, poles, sewers, drains, fire hydrants, and other structures which, in the opinion of the utility company, do not require relocation shall be carefully supported, shored up, the flow maintained, if applicable, and the line/main/obstruction protected from damage by the Contractor. If damaged, the Contractor shall give immediate notice to the proper authorities. The

utility shall be restored, at the Contractor's expense, by the appropriate utility to original or better condition. The Contractor shall be responsible for any damage to persons or property caused by such breaks. Assess no cost to Town, Engineer, or auxiliary party for any damages.

C. The Contractor shall be responsible for anticipating and locating underground utilities and obstructions. When construction appears to be in close proximity to existing utilities, the trench(es) shall be opened a sufficient distance ahead of the work or test pits made to verify the exact locations and inverts of the utility to allow for changes in line and grade.

D. If active utility lines are encountered, and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted.

E. Should it become necessary to move the position of any underground structure, when approved by the Town's Engineer, the Contractor may be required to do such work.

F. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Town's Engineer and secure instructions. Do not proceed with permanent relocation of utilities until written instructions are received from the Town's Engineer and the owner of the conflicting utility.

3.1.4. PROCEDURES FOR REPAIRING DAMAGED UTILITY SERVICES

A. If a located service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the Town. Notification shall be made to the Utility owner.

B. House services: If any utility to an adjoining house is broken, the Contractor shall repair it at once and at his expense. The Town or the owner of the affected Utility Company/Agency may, at the Contractor's expense, repair any such service without prior notice to the Contractor.

C. If damage results from the action of either a public or private party on a newly constructed project to be accepted by the Town of Wake Forest (e.g. water, sanitary sewer, storm sewer, or street), immediate notification shall be given to the Town's Engineer or Town Inspector. All damages or interruption shall be the responsibility of the party causing the damage.

3.1.5. PROTECTION OF SURFACE FEATURES

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, sediment deposition, project related sink holes, and other hazards created by operations under this or other related sections.

B. The Contractor shall provide pads or take necessary precautions to protect the pavement from damage by the construction equipment. Pavement damaged by cleated or tracked equipment, or by any other means, shall be repaired by the Contractor at his expense to the satisfaction of the Town's Engineer.

C. Where a storm drainage line is placed in an existing paved area, the Contractor shall use care to cut in sharp, neat lines ahead of the excavating/ditching equipment and parallel to the pipe on each side as may be applicable. If the existing road to be cut is located within another jurisdiction other than the Town of Wake Forest or within NCDOT rights of way, the Contractor is responsible for contacting the local representative or NCDOT, respectively about pavement repair/replacement.

D. Avoid overloading or surcharge by keeping equipment and material a sufficient distance back from edge of excavation to prevent slides or caving. Maintain and trim excavated materials in such manner to be as little inconvenience as possible to public and adjoining property.

E. Provide full access to public and private premises, to fire hydrants, at street crossings, sidewalks and other points as designated by the Town's Engineer to prevent serious interruption of travel.

F. Protect and maintain benchmarks, monuments, or other established points and reference points, and if disturbed or destroyed, items shall be replaced by a Licensed Professional Surveyor to the full satisfaction of the Town's Engineer and/or the jurisdictional agency.

G. See paragraph 1.10, Coordination regarding traffic signals.

3.1.6. PROTECTION OF PERSONS AND PROPERTY

A. Barricade open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or with public access.

B. The contactor shall not enter upon private property for any purpose without first obtaining permission. He shall use every precaution necessary to prevent damage or injury to any public or private property, trees, fences, monuments, and underground structures, etc., on and adjacent to the site of the work. He shall protect carefully from disturbance or damage all land monuments and property markers until an authorized agent has witnessed or otherwise referenced their locations, and shall not remove them until directed.

The Contractor shall be responsible for all damage or injury to property of any character resulting from any act, omission, neglect, or misconduct in his manner or method of executing said work, from his non-execution of work, or from defective work or materials, and he shall not be released from said responsibility until the work shall have been completed and accepted.

C. The Contractor shall, at his own expense, sustain in their places and protect from direct or indirect injury all pipes, poles, conduits, walls, roadways, buildings, and other structures, utilities and property in the vicinity of his work. Such sustaining and supporting shall be carefully done by the Contractor and as required by the Company or party owning the structures or Agency controlling it. The Contractor shall take all risks attending the presence or proximity of pipes, poles, conduits, walls, thereof and any costs associated will be deducted from any monies due the Contractor. Failure of the Town's Engineer or his/her authorized representative to direct the correction of unsafe conditions or practices shall not relieve the Contractor of his responsibility hereunder.

D. When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, the contractor shall restore such property, at his own expense, to a condition equal to or better than that existing before such damage or injury was done. The contractor shall make good such damage or injury in an acceptable manner by repairing, rebuilding or otherwise restoring as directed.

E. The Contractor shall provide barricades, fences, coverings, or other types of protection necessary to prevent damage to existing improvements, not indicated to be removed, and improvements on adjoining property. Trees and shrubs that are to remain within the construction limits will be indicated on the drawings or conspicuously marked on site.

F. Contractor shall protect existing tress and other vegetation indicated by the Town's Engineer to remain in place against limb, bark or root damage such as cutting, breaking, or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line.

3.2 CLEARING AND GRUBBING

A. See UDO Chapter 8, Tree Protection, Buffers and Landscaping for requirements.

B. **Disposal:**

1) Debris from the site shall be removed in such a manner as to prevent spillage. Keep pavement and area adjacent to site clean and free from mud, dirt, dust, and debris at all times.

2) All brush, tree tops, stumps, and debris shall be hauled away from site or otherwise disposed of in a manner acceptable to the Town's Engineer. The contactor shall clean up debris resulting from clearing operations continuously with the progress of the work and remove promptly all salvageable material that becomes his property. Such material is not to be reused in construction. Sale of material at or on the site is prohibited.

3) Stumps of trees cut down outside of the excavation area will be removed. Perishable material shall not be disposed of at the construction site.

4) Unless removed from site for chipping/shredding and recycling, brush, laps, roots, and stumps from trees shall be disposed of in a NCDENR approved and permitted land clearing and inert debris type landfill. Disposal of cleared material shall be in accordance with all local and state laws.

5) The Contractor will be responsible for obtaining all applicable permits and paying all fees for the disposal of excess material.

3.3 STRIPPING OF TOPSOIL:

A. Remove the existing topsoil to a depth of 6 inches or to the depth encountered from all areas in which excavation will occur. The topsoil shall either be stored in stockpiles separate from the excavated trench material if the topsoil is to be respread or otherwise disposed of off-site. Topsoil stockpiles shall be graded to freely drain

surface water, and shall have a silt fence placed around the base of the stockpile and/or other measures required by the Erosion and Sedimentation Control Plan/Permit.

3.4 DEWATERING

A. **Water in Trenches and Pits:** Do not allow water to accumulate in excavations. When ground water is encountered, the contractor shall remove the water that accumulates in the trenches or pits, which would affect the construction of the lines or their appurtenances, by pumping, bailing, well-pointing, or other approved dewatering method and shall perform all work necessary to keep the trenches or pits entirely clear from water while bedding is being placed, the pipe is being laid, masonry units are being placed, and structures are either being set or constructed. No drainage structure shall be constructed in water.

B. All water removed from the trench shall be conveyed in a proper manner to a suitable point of discharge and shall comply with applicable erosion and sedimentation control laws. The contractor shall dispose of water from the trenches in such a manner to cause no injury to public health, public or private property, work completed or in progress, street surfaces, or where such effluent may cause any interference with the use of the streets. Water, if odorless and stable, may be discharged into an existing storm drain, channel, or street gutter in a manner approved by the Town's Engineer. When required by the Town's Engineer, a means shall be provided for de-silting (filtering) the water before discharge. Under no circumstances shall water be discharged to a sanitary sewer main or sewer related structure.

C. Where underground streams or springs are encountered, provide temporary drainage, well pointing, or bailing. Notify the Town's Engineer of such conditions.

D. Protect subgrade from softening, undermining, washout, and damage by rain or water accumulation. Include cost of de-watering in proposal for water or sewer lines. No additional remuneration for this item is permitted.

E. Maintain dewatering systems until dewatering is no longer required.

F. Prevent surface water from ponding on prepared subgrades and from flooding project site and the surrounding area. Reroute surface water runoff away from or around excavated areas.

G. Unless otherwise directed by the Town's Engineer, the cost of shoring, sheeting, well pointing, gravel bedding and other dewatering devices shall be included in the unit price of each respective item bid. Do not use excavated trenches as temporary drainage ditches.

H. Backfilling shall not take place when the trench contains water in an amount to create soupy conditions.

I. Dewatering is not a pay item.

3.5 TRENCHING

3.5.1. GENERAL:

A. **Unclassified Trench Excavation:** Remove all material of whatever nature, including but not limited to clay, silt, gravel, and hard pan, as directed by Town's Engineer and dispose of unsuitable material in either a NC DENR permitted demolition land fill or a site which legally can accept earthen fill (i.e. meeting all applicable laws such as erosion control, zoning, etc.). Material, of a compactible nature, that can be re-used as trench backfill shall be replaced and re-compacted to the requirements set forth in these specifications.

The cost of excavation is to include all costs for equipment, personnel, trenching, shoring, de-watering, well-pointing, removal and replacement of material, compaction, testing, or disposal if material is deemed unsuitable by the Town's Engineer or his representative. The cost of rock of trench rock removal by blasting or other mechanical means (except ripping) is not included in unclassified trench excavation cost.

B. **Excavation for Drainage Structures:**

This item consists of the necessary excavation for the foundation of bridges, pipe and box culverts, and all other drainage structures for which foundation excavation is not otherwise provided under the individual items; necessary excavation for under drains; disposal of all excavated material of whatever nature (with the exception of rock by blasting or mechanical means other than ripping); all necessary bailing, drainage, pumping, sheeting, shoring and bracing; and the construction of cribs and cofferdams, including the furnishing of materials thereof, all as specified and in conformity with the requirements of these structures, as shown on the drawings.

C. **OSHA Trench Protection:**

Excavation shall be performed in accordance with OSHA Standard 29 CFR Part 1926, "Safety and Health Regulations for Construction," Subpart P "Excavations," Standard Number 1926.650, latest revision., latest revision. The Contractor shall hold the Town of Wake Forest harmless for injuries and/or damages resulting from failure to properly adhere to trench protection regulations/requirements in force at the time of a failure or mishap.

3.5.2. TRENCHING (GENERAL)

A. The trench for storm drainage pipe shall be excavated to conform to Standard Detail 9.53.

B. Unless given permission to do otherwise or shown as a bore, all excavation of trenches is to be by the open cut method to the depth and grade shown on drawings and as necessary to accommodate work.

C. The contractor shall only open as much ditch as he can completely install pipe, backfill, compact, and cleanup within that working day. Do not open a greater length of trench than can be effectively utilized and maintained under existing conditions and with the forces at hand. The maximum allowable length of open trench shall be limited to 1000 LF per work crew.

D. Once trench is opened, proceed immediately and with dispatch to place specified materials in trench, or to otherwise utilize trench for intended purpose. Schedule work and order materials so that trenches are not left open for a longer period than is

reasonably necessary. Any trench or portion of trench, which is opened and remains idle for seven calendar days or longer, as determined by the Town, may be directed to be immediately refilled, without completion of work, at no additional cost to Town. Said trench may not be reopened until Town is satisfied that work associated with trench will be prosecuted with dispatch.

E. Containment of Sediment (solids and mud): The contractor shall at all times so conduct his work to ensure that all solids and mud are contained within the trench. See paragraph 3.5.7, Surface or Groundwater In Trenches, below.

3.5.3. TRENCH PROTECTION: TRENCH SHAPING, BRACING & SHORING

A. A Certified Competent Person designated by the Contractor shall be on-site at all times excavation or pipe installation is being conducted. OSHA standards must be adhered to.

3.5.4. PREPARATION OF TRENCHES FOR STORM DRAINAGE PIPELINES

A. The bottom of the trench for storm drainage pipelines shall be excavated to a minimum over depth as shown on the construction drawings in accordance with the applicable type laying condition specified (as shown on Standard Detail 9.53) to provide for pipe bedding for the entire length of the gravity pipeline, including lateral connections if any, except in rock where foundation bedding shall be prepared as specified on Standard Detail 9.53. Unless otherwise directed by the Town's Engineer, the bedding shall be shaped to conform to Standard Detail 9.53. Bell holes and depressions as required of the joint shall be dug after the bedding has been graded and shaped, and shall be only of such length, depth, and width as required for properly making the particular type of joint. Rock larger than 3 inches shall be removed from the trench bottom and any voids filled with compacted NCDOT Class II or III material (Section 1016, *Select Material*, NCDOT Standard Specifications for Roads and Structures). The trench for storm drainage and lateral connections, if any, shall then be backfilled and compacted as indicated Standard Detail 9.53, Table 2 taking care to compact in no more than 8-inch lifts with the fill brought up evenly on both sides of the pipe at the same time to avoid unbalanced pressures. The balance of the trench backfill up to pavement subgrade, or finished grade as applicable, shall conform to Table 2210.1 and paragraph 3.6.3.B of this specification.

B. Notify Town when unstable materials are encountered and define by drawing station locations and limits when encountered. Where an unsuitable foundation is encountered, provide a stone foundation with NCDOT Type 4 soil stabilization fabric in accordance with Standard Detail 9.53.

C. Over-excavation: Unauthorized over-excavation consists of removal of material beyond indicated subgrade elevations or side dimensions, without specific approval of the Town's Engineer. Exercise care to avoid excavations below established grade where firm earth conditions exist. Where unauthorized excavations have been carried beyond points required, restore these areas to the elevations and dimensions shown on the drawings with approved fill material and compact as specified (as noted in the preceding paragraph). In no case shall the pipe be brought to grade by blocking under the barrel of the pipe. A uniform support shall be provided for the entire length of the pipe. Unauthorized excavation shall be replaced at the Contractor's expense.

3.5.5. EXCAVATION FOR STRUCTURES

A. Excavate to provide a minimum of 12 inches of horizontal clearance between outer surface of structure and trench wall.

B. Excavating and Backfilling for Structures: See specification Section 02200 *Earthwork*, paragraph 3.4 *Structures: Excavation and Backfilling.*

C. See 3.5.6.G Cushioning for Structures for bedding requirements.

D. See also paragraph 3.5.3, Trench Protection.

3.5.6. **ROCK:**

A. **Rock Excavation:** See paragraph 1.4.N, Rock Excavation for Trenches and Pits for definition of rock excavation.

B. When rock is encountered in the trench, the Town's Engineer must be notified before any rock is blasted or removed. Do not perform rock excavation work until rock has been cross-sectioned, classified, and approved for removal by the Town's Engineer. The Town's Engineer will measure the rock, after which, the rock shall be excavated to a depth 6 inches below the grade of pipe and the bottom of trench brought back to grade by using an approved fill material. See paragraph 3.16, *Blasting* for other requirements regarding rock excavation.

C. Intermittent drilling, blasting, or ripping performed to increase production and not necessary to permit excavation of material encountered will be deemed to be unclassified excavation

D. All over-blasted rock which has been loosened must be removed prior to backfilling.

E. The Contractor must use overburden, mats, or other means to minimize fly-rock. Any damage caused by flyrock or excessive vibration will be the responsibility of the Contractor.

F. **Cushioning Pipe In Rock:** Special precautions shall be exercised to prevent any pipe from resting on rock or any other hard projection that might cause breakage of pipe. At no time shall the pipe bell or the pipe barrel rest on rock. A minimum of 6 inches of NCDOT Class V or VI (Section 1016, *Select Material*, NCDOT Standard Specifications for Roads and Structures) foundation cushioning is required between the outside barrel of the pipe and rock. A minimum of 12 inches of clearance is required between the sides of the pipe and the rock. Thicker cushioning may be required for deeper or large pipe on a case-by-case basis. See Table 2 on Standard Detail 9.53.

G. **Cushioning for Structures:** The bottom of manhole bases and other precast structures and appurtenances shall be excavated to minimum over depth of 8 inches below the bottom of the structure (or more if directed by the Town's Engineer), but no less than as indicated in the applicable standard details. The structures shall be placed on clean stone bedding (NCDOT Class VI [Section 1016, *NCDOT Standard Specifications for Roads and Structures*]) that has been firmly consolidated. Bedding material shall be shaped, graded, and compacted so that the entire bottom of the structure rests level on the material for its entire area.

H. **Disposal of Rock:** Rock excavated from the trench shall be hauled off the site at the Contractor's expense. Borrow required to replace excavated rock shall be provided by the Contractor and shall be included in the unit price bid for rock excavation. No rocks or boulders shall be used as backfill in any part of the trench. Where rock has scattered over adjoining property as a result of blasting, the Contractor shall remove the rock and restore the area to its original condition at no cost to the Town.

I. See also paragraph 3.5.3, Trench Protection.

3.5.7. SURFACE OR GROUNDWATER IN TRENCHES/PIPE

A. See paragraph 3.4 – *Dewatering*, of this specification.

B. Existing or newly laid storm drainage pipe shall either be plugged and/or an appropriate sediment trap placed at the upstream end to prevent siltation at the end of a day's work.

3.5.8. TRENCH SIZE/SHAPE:

A. Trench size: Conform to the requirements of Standard Detail 9.53.

3.5.9. PIPE EMBEDMENT

A. Observe drawing notations for specifics regarding embedment conditions.

B. Refer to specific pipe material specifications for additional embedment requirements.

C. Note special details for drain pipes and foundation drains.

3.5.10. BEDDING CONDITION

A. Refer to the following table.

Pipe Condition	Installation Type[a]
RCP in R/W (Paved Areas)	Type 1 or 2
RCP Outside R/W (Outside of Pavement or in Natural Areas)	Type 3 or 4

[a]See Table 2, Standard Detail 9.53.

B. Bedding Pipe in Rock: See paragraph 3.5.6.F Cushioning Pipe in Rock, above.

C. Bedding for Structures: See paragraph 3.5.6.G Cushioning for Structures, above.

3.6 BACKFILLING (MATERIALS AND METHODS)

3.6.1. GENERAL:

A. Except as otherwise specified or directed for special conditions, backfill trenches to the ground surface with select material approved by the Engineer.

B. Reopen trenches that have been improperly backfilled, to a depth as required for proper compaction. Refill and compact as specified, or otherwise correct to the approval of the Engineer.

C. Do not allow or cause any of the Work performed or installed to be covered up or enclosed by work of this Section prior to required inspections, tests, and approvals.

D. Should any of the Work be so enclosed or covered up before it has been approved, uncover all such Work and , after approvals have been made, refill and compact as specified, all at no additional cost to the Town.

E. No separate payment shall be made for the excavation or backfilling for storm drains.

F. Observe specific pipe manufacturer's recommendations regarding methods of backfilling and compaction.

G. Ensure compaction of each lift to requirements stated in these specifications.

H. All pipe areas shall be graded and maintained in such a condition that erosion or saturation will not damage the pipe bed or backfill.

I. Pipe and fittings shall be inspected before backfilling.

J. Unless otherwise directed or permitted by the Town's Engineer, all pipe laid shall be backfilled during the same day, and prior to the completion of the day's work, to provide a firm continuous support and covering for the pipe.

K. Heavy equipment shall not be operated over any pipe until it has been properly backfilled and compacted with a vibratory compaction device (i.e. Rammax walk behind or infrared remote controlled trench roller/compactor (24- to 33-inch drum), NOT A PLATE TAMP) and has a minimum cover as required by the plans. Pipe that is misaligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations, shall be removed and replaced at no cost to the Town.

3.6.2. MATERIALS:

A. Use only backfill for trenches which is free from boulders, large roots, sod, other vegetation or organic matter and frozen material.

B. See *paragraph 2.1.1 – Trench Backfill Material Classification* for Select Earth Backfill and Common Trench Backfill classification. In areas of extensive rock excavation, where there is a shortage of suitable backfill, the contractor shall, at his own expense, haul suitable material in to be placed over the pipe.

3.6.3. METHODS:

Provide backfill and compaction methods of following types:

A. **Carefully Compacted SELECT EARTH BACKFILL:** Furnish carefully compacted select earth backfill where indicated on drawings and specified for trench embedment conditions and for compacted backfill conditions up to 12 inches above top of pipe. See paragraph 2.1.1.A *Soil, Bedding, and Backfill* for definition of Select Earth Backfill. Comply with the following:

1) Do not backfill on muddy or frozen subgrade.

2) Exercise extreme care in backfilling operations to avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, distortion or damage to newly made joints.

3) The filling of the trench shall be carried on simultaneously on both sides of the pipe in such a manner that injurious side pressures do not occur such that the pipe could be displaced or dislodged.

4) Repair damages, distortions, or misalignments to the full satisfaction of the Town's Engineer.

5) Pipe shall be removed if broken or damaged during installation.

6) Sheeting and shoring generally should be removed only when the trench below it has become substantially filled, and every precaution shall be taken to prevent any slides of material from the sides of the trench onto or against the pipe. See paragraph 3.5.3 Trench Protection.

7) Unless otherwise approved by the Town's Engineer, place backfill in lifts not exceeding 8 inches (loose thickness) up to 12 inches above top of pipe.

8) Hand place, shovel slice, and hand tamp carefully compacted backfill solidly around pipe (see Standard Detail 9.53). Only hand tamping shall be used to compact earth around the pipeline. When the backfill has been brought to 12 inches above the top of the barrel, vibratory compaction devices (i.e. Rammax walk behind or infrared remote controlled trench roller/compactor (24- to 33-inch drum), NOT A PLATE TAMP) shall be used to compact the remainder of the soil.

B. **COMMON TRENCH (FINAL) BACKFILL** Perform remaining backfill in accordance with drawings or as directed by the Town's Engineer. See paragraph 2.1.1.B *Trench Backfill Material* Classification for definition of Common Trench Backfill. Comply with the following:

1) Unless otherwise specified or approved by the Town's Engineer, backfill the remainder of the trench, from 12 inches above the pipe to grade, with clean earth fill free of stones larger than 3 inches in diameter. Top 12 inches to be free of material greater than 1 inch. Material shall be free from all perishable and objectionable materials (organic). Before placing any backfill, all rubbish, forms, blocks, wires, or other unsuitable material shall be removed from excavation.

2) The material for backfilling, unless otherwise specified, shall be Select Backfill of sand-clay mix or a material approved by the Engineer and free from stones larger than two inches (2 inches) in diameter.

3) From 12 inches above the pipe to grade, the backfilling shall be placed in layers not over 8 inches thick in the street right of way and 12-inch layers outside of the street right of way compacted to a minimum density as specified in Table 2210.2. See also Table 2210.1.

4) If permitted by the Engineer, after pipe has been covered to a depth of one foot, puddling may be used in the consolidation/compaction of granular backfill, and the trenches filled with water as backfilling progresses. Stones used in the

puddled backfill shall not be larger than three inches (3 inches) in diameter and enough earth shall be used to fill all voids completely.

5) Final backfill shall be tamped with a vibratory compaction device (i.e. Rammax walk behind or infrared remote controlled trench roller/compactor (24- to 33-inch drum), NOT A PLATE TAMP). See Table 2210.2 below, for specific density requirements.

6) All areas within the limits designated on the drawings, including adjacent transition areas, shall be uniformly graded. The contractor shall finish surfaces within the specified tolerances with uniform levels or slopes between points where elevations or existing grades are shown.

   a. Finish subgrade areas that are to receive topsoil. Bring such areas to within 0.10 foot of required subgrade elevations.

   b. Shape subgrade under sidewalks to line, grade, and cross-section. Subgrade is to be brought to within 0.10 foot of required subgrade elevations.

   c. Shape subgrade under pavement to line, grade, and cross-section. Bring to within ½ inch of required subgrade elevations.

7) **Surface Protection – Traffic**: The contractor shall protect newly graded areas from traffic and erosion, repair, and re-establish grade in settled, eroded, or rutted areas. Where compacted areas are disturbed by subsequent construction or adverse weather, the contractor shall scarify the surface, reshape, and re-compact to the required density.

8) On Town funded projects, should the contractor fail to maintain any trench within 2 days after notice from the Town's Engineer, the Town may address/remediate the trench problem and the cost of such work may be retained from monies due the contractor. In case of emergency, the Town's Engineer may refill any dangerous trench failures or depressions without prior notice to the Contractor.

C. **Structure Backfill:** Backfill placed within 2 feet of manholes and other special structures shall be of the same quality as that specified for backfill around water, sewer or storm drainage lines. Take care to prevent wedging action of the backfill against structure by carrying the material uniformly around the structure so approximately the same elevation is maintained in each lift. If necessary to prevent damage to structure, provide temporary bracing of structure walls. Material shall be solidly tamped with a mechanical or pneumatic tamper in such a way as to avoid damaging the structures or producing unequal pressures. The Contractor shall refill all excavations as rapidly as practical after completion of the structural work therein, or after the excavations have served their purpose.

D. **Flowable Fill Concrete Backfill**

1) See paragraph 2.1.5, *Flowable Fill Concrete Backfill* for product specification.

2) When directed by the Engineer, the Contractor shall backfill trenches or undercut areas with flowable fill concrete plant mix. Concrete strength shall be as specified by the Engineer based on the application (excavatable vs. non-excavatable).

Except for structural applications, traffic can be placed on mixture within an hour or two after placement. Final surfacing of pavements; however, should be delayed if possible at least 24 hours to allow for shrinkage and hydration of concrete. Settlement of 2" to 3" may occur.

3) The option to use flowable fill is open to the Contractor to reduce delay and inconvenience to traffic. However, payment for flowable fill backfill is considered incidental to the cost of construction unless either a pay item has been provided in the proposal, a change order has been approved or the Contractor is ordered by the Engineer to place flowable fill concrete as an emergency measure. Before placing flowable fill in NCDOT rights-of-way, obtain verbal approval from District Engineer's office.

E. **Special Method Requirements.**

1) Water flushing for consolidation is permitted with permission of Engineer only.

3.6.4. COMPACTION LIFTS:

A. **Minimum Compaction Requirements:** Compaction percentages are percentages of maximum dry density as determined by indicated ASTM Standards. Unless noted otherwise on drawings or more stringently by other sections of these specifications, place and ensure degree of compaction of trench backfill and/or borrow material does not fall below the following percentages of the maximum density at optimum moisture content.

Table 2210.1	
Compaction Lift Thickness for Common Trench Backfill[a]	
Lift Thickness (inches)	**Location**
8	Inside street rights-of-way
12	Outside street rights-of-way
[a]Carefully Compacted Select Earth Backfill lifts shall not exceed 8 inches.	

B. **Passing Test:** Average of 3 test results meeting the applicable provisions of Table 2210.2 (above) with no one test failing by more than -3 percentage points. Moisture content tolerance is to be within +/- 3 percentage points of the optimum moisture content unless otherwise specified by the Town's Engineer or Geotechnical Engineer.

C. **Failure of compactive efforts:** If compaction efforts should fail to provide a stable subgrade in accordance with the requirements in paragraph 3.6.4.B, Passing Test after subgrade materials have been shaped and brought to optimum moisture, such unstable materials shall be removed to the extent directed by the Geotechnical Engineer and/or the Town's Engineer and replaced and compacted using new material and must pass compaction test prior to proceeding to the next stage of construction and at no expense to the Town.

D. The costs associated with excavation and re-compaction of areas that have failed will be the Contractors responsibility.

3.7 PIPE COVER

1) Where utility runs transverse public property or are subject to governmental or utility company jurisdiction, provide depth, bedding, cover, and other requirements as set forth by legally constituted authority having jurisdiction, but in no case less than the depth shown in the Contract Documents.

2) Provide minimum trench depth indicated in the Fill Height Table shown in Standard Detail 9.53, **over the top** of the installed item below the finish grade or subgrade

3) Where the minimum cover is not provided, encase the pipe in concrete as indicated. Provide concrete with a minimum 28-day compressive strength of 2500 psi.

3.8 COMPACTION

A. Soil shall be compacted using equipment suitable for the material and the work area location. Power driven hand tampers shall be used for compacting materials adjacent to structures. Use hand tamper for re-compaction over underground utilities.

B. **Minimum Compaction Requirements:** Place and ensure backfill and fill materials achieve an equal or "higher" degree of compaction than undisturbed materials adjacent to the work. Compaction percentages are percentages of maximum dry density as determined by indicated ASTM Standards. Unless noted otherwise on drawings or more stringently by other sections of these specifications, place and ensure degree of compaction of trench backfill and/or borrow material does not fall below the following percentages of the maximum density at optimum moisture content.

Table 2210.2		
Minimum Compaction Limits (Cohesive Soils)		
Location	**Density**	
Beneath and within 5 feet of buildings	100% of the maximum dry density by ASTM D698 (standard Proctor), AASHTO T-99.	
Areas under roadway pavement surfaces, curb and gutter, and sidewalks	Top 12 inches	100% of the maximum dry density by ASTM D698 (standard Proctor), AASHTO T-99.
	Up to within 12 inches	95% of the maximum dry density by ASTM D698 (standard Proctor), AASHTO T-99.
Roadway shoulders	95% of the maximum dry density by ASTM D698 (standard Proctor), AASHTO T-99.	
Under turf, sodded, planted, or seeded non-traffic areas	85% of the maximum dry density by ASTM D698 (standard Proctor), AASHTO T-99.	

3.9 TESTING

A. Tests shall be performed by a recognized independent testing laboratory approved by Town. The Contractor shall be responsible for excavation for testing.

B. **Quality Assurance vs. Quality Control**:

1) Quality Assurance (QA) Testing, and the associated cost, is the responsibility of the Town. Quality Assurance testing by the Town is used to confirm that the Contractor is generally performing his/her work in compliance with these specifications and that the trench backfill complies with specified minimum compaction requirements.

2) **Quality Control (QC) Testing** is the necessary and required testing that is to be performed by the Contractor to assure that he/she is meeting and complying with the requirements of these specifications. The associated cost for QC testing is the Owner/Developer/Contractor's responsibility as directed by the these specifications. The contractor is also responsible for "re-testing" costs incurred by the Town when the Town's test results (tests for Quality Assurance) results in a "failure."

3) **Quality Control (QC) Testing for Town Funded Projects**: For Town funded projects, the Town of Wake Forest shall pay for the cost of testing. However, where backfill compaction is suspect and questionable, the material shall be removed as directed by the Town's Engineer or his representative and the area tested. If the suspect area fails to meet the prescribed minimum moisture density test requirements, the soil shall be removed, replaced, compacted and re-tested, as directed by the Town's Engineer until the backfill meets or exceeds the minimum density requirements. The Contractor shall pay for all costs associated with re-testing.

C. **Quality Assurance (QA):**

In the course of backfilling trenches for utility installations, the Town's Engineer may require "Field Density Determinations" or compaction tests. When compaction tests are called for, the Town's Engineer will determine the location of the tests and the Town shall engage a qualified testing firm to perform the test. A representative of the Town will observe tests and a copy of the test results and inspection report will be submitted by the testing firm directly to the Town's Engineer. When the tests indicate that the density failed to meet the requirements of Table 2210.2, the Contractor shall comply with paragraph 3.6.4.C, Failure of Compactive Efforts.

Payment for failed QA density tests: For Town funded projects, payment for failed in-place density tests shall be made by the Contractor by deducting the testing cost from the forthcoming retainage. For other projects in which the Town will ultimately assume ownership and maintenance, the testing costs for failed in-place density tests shall be billed directly to the Contractor.

D. **Quality Control (QC):** The Contractor shall perform in-field density tests in accordance with **Table 2210.2**. Inspection reports shall be submitted by the testing firm directly to the Town's Engineer. See paragraph 3.6.4.B, Passing Test.

1) All test results shall be provided to the Town's Engineer as they become available from the testing agency.

2) The Geotechnical testing firm is to perform laboratory tests (ASTM D698, standard Proctor) to establish a moisture-density relationship for all materials that are proposed to be used as fill.

3) Contractor shall give a 24-hour notice to Geotechnical testing firm for subgrade testing, subgrade confirmation, or inspections.

E. **Testing Frequency:**

Table 2210.3	
Testing Frequency	
Location	**Frequency**
Trench areas in road crossings	1 test group[a] per road crossing, and/or
Trench areas	1 test per 100 linear feet per two feet of fill thickness
Exceptions: Where additional tests are required to determine the extent of unacceptable compaction (having been determined by the initial QA/QC test). In this case, the costs for these additional tests are the responsibility of the Contractor.	

F. **Site Access For Testing:** Ensure the Town, at all times, has immediate access to the site for the testing of all soils related work. Ensure excavations are in a safe condition for testing personnel.

G. Reference to Engineer in this section will imply Soils Engineer when employed by Town and directed by Engineer to undertake necessary inspections and approvals as necessary.

3.10 SUBSURFACE DRAINAGE

A. Installation of subsurface drainage systems shall conform to the requirements of Section 815 – *Subsurface Drainage* of the NCDOT *Standard Specifications for Roadways and Structures*.

3.11 DEPOSITION OF EXCAVATED MATERIAL

A. All excavated material shall be placed on one side of the trench (a minimum of 2 feet from the edge of excavation but no less that that specified/required by OSHA regulations) away from the roadway unless permission is given by the Town's representative to place it on both sides. Excavated materials shall be so placed as not to endanger the work and so that free access may be had at all times to all parts of the trench and to all fire alarm boxes, fire hydrants and gate valves on water pipes, which are located in the vicinity. Excavated material shall be placed to in such a way as to inconvenience the public as little as possible. All fences and walls shall be protected and, if damaged, shall be repaired or replaced in as good or better condition as before it was disturbed. Protect shade trees from stockpiling of material.

B. Exercise care when stockpiling excavated material on the bank in order to prevent surcharging the bank of the trench and potentially rendering the excavation unstable.

C. **Disposal/Wasting of Unsuitable Material:** Material of an uncompactable nature, material unsatisfactory for backfill, trash, and excess material shall be removed from project site and disposed at the Contractor's expense. Where removal of unsatisfactory material is due to negligence on the part of the Contractor (i.e. resulting from inadequate shoring or bracing, failure to dewater, improper material

storage exposing it to rain or flooding, or other failure to meet specified requirements), work shall be performed at no additional cost to the Town. If additional material is required, the contractor shall supply same from an approved borrow pit at no additional cost to the Town. Rock excavated from the trench shall be hauled off the site at the Contactors expense.

3.12 PLACEMENT OF RIP RAP AND RIP RAP BEDDING

Placement of Rip Rap and fabric shall conform to Section 876 – *Rip Rap* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision, to the requirements of NCDENR Division of Energy, Mineral and Land Resources, Land Quality Section's *North Carolina Erosion and Sedimentation Control Planning and Design Manual*, latest revision and to the details shown on the approved plans.

3.13 PAVEMENT REPAIR AND REPLACEMENT

A. **General:** This work shall consist of replacing subbase stone, and bituminous material in the street in areas where it becomes necessary to remove the original pavement for sewer, water main, and storm drainage trenches. Pavement repair shall be as shown on the drawings or as determined by the Town's Engineer. However, the pavement surface repair shall conform to the minimum requirements shown on Standard Detail 9.06. The pavement patch shall provide a uniform and smooth driving surface free of humps or depressions.

B. **Construction in Public Rights of Way**: Storm drainage lines installed in or across NCDOT roads shall be installed in accordance with, if applicable, the requirements stipulated in the approved encroachment permit and the latest requirements of both the NCDOT *Standard Specifications for Roads and Structures* and the *Roadway Standard Drawings*. All storm drainage lines installed in or across Town streets shall be in accordance with these specifications and the applicable standard details.

C. When it is necessary to remove the existing pavements, prepared road surfaces, sidewalks, or curbing, it shall be the responsibility of the Contractor to replace these surfaces to original or better condition. The Contractor shall be responsible for contacting the Town or the NCDOT, as applicable. Unless specified more stringently by the owner of the right of way, the backfill shall be compacted in accordance with Table 2210.2.

D. Contractor shall replace pavement base such that the trench backfill conforms to the requirements of Standard Detail 9.06.

E. When storm drainage lines are installed in or across roadways that have been macadamized or graveled, the Contractor shall save the gravel or stone, refill the upper 12 inches of the trench with the material, and supply sufficient new stone or gravel to return the roadway to the original grade. It shall be the Contractor's responsibility to maintain the original grade by adding gravel or ABC until the ditch is stable and the pipeline accepted by the Town. Maintain area as outlined in paragraph 3.6.3.B.7 – Surface Protection – Traffic.

F. **Cutting Pavement:** See also Standard Detail 9.06 and paragraph 3.1.5 – *Protection of Surface Features*. Perform cutting operations prior to installation of line to avoid excessive removal of asphalt.

G. **Protection of Pavement:** See paragraph 3.1.5 – *Protection of Surface Features*.

3.14 RAILROAD CROSSING/TRACKS

Crossing of railroad tracks with storm drainage lines shall be by the method shown on the contract drawings and approved by the applicable Railroad Company. It is the responsibility of the Project Engineer and Contractor to contact the Railroad Company and to comply with all Railroad Company requirements for specifications, drawings, permits, etc. All storm drainage lines installed beneath railroad tracks shall be in accordance with the Railroad Company's policies, procedures, and permits requirements. The railroad right of way and track structure shall be fully restored to its original pre-existing condition and to the full satisfaction of the Railroad Company. The work shall not interrupt the use of the railroad tracks or in any way endanger the traffic on them.

3.15 GROUTING

A. Where designated on the plans or instructed by the Engineer, low strength tunnel slurry grouting shall be employed to fill voids, under floors, behind walls or behind tunnel liners.

B. **Methods**

1) Limestone Screening and Cement Method: The Contractor shall mix one part cement to 6 parts limestone screenings to form a slurry paste. Limestone dust or baghouse dust is best and may be obtained from quarry sources such as Georgia Marble. To this mixture add 1/3 lb. of a water reducing agent or super plasticizer to each 100 lbs. of cement. Keep water content low to minimize shrinkage. Pump or pour slurry into voids.

2) Fly Ash and Cement Method: The Contractor shall mix six parts fly ash with one part cement to form a flowable paste. To this mixture add 1/3 lb. of a water reducing agent or super plasticizer to each 100 lbs. of cement to reduce shrinkage. Do not add sand as it will segregate to the bottom of the slurry. Keep water content low to minimize shrinkage. Pump or pour slurry into voids.

3) Specco Polyurethane (Expanding Foam) Grout: Where directed by the Engineer, drill or core holes through floor or walls. Lightly spray or dampen the surface behind the structure with water, if it is not already damp. (Do not flood or pond water - a thin layer of moisture is all that is needed).

   Using Specco Polyurethane Grout, pour slowly the premixed two-part mixture of urethane grout into the injection holes. The grout will begin to expand in about 30 to 60 seconds after contact with the water to 10 to 15 times its original volume. The volume of urethane used should not exceed 1/10 the total volume of the void being filled. Make sure that the hole and the area outside the hole is dry to prevent premature foaming or hole closure.

   Hole placing should be coordinated with the Engineer and the foam manufacturer.

   Specco "U-Mix" Polyurethane Grout can be obtained from Specco Industries, Chicago, Illinois. Approximate bearing strength is 100 psf.

4) Once the voids are full, clean out the ports or holes and seal off hole. For concrete floors or walls, use Five Star General Purpose Non-Shrink Grout. For steel tunnel liners, cap off with liner plate or plugs.

3.16 BLASTING

3.16.1. GENERAL

A. Contact the town of wake forest inspections department.

B. Payment: Rock excavation shall be paid for the actual excavation volume up to a maximum of 5 foot in width for pipes with an I.D. of 42" or less. For pipe I.D.'s greater than 42", add 18" to the pipe I.D. This method assumes that for pipes larger than 24" that the pipes are backfilled to the spring line with either #57 or #67 clean stone. See Trench Payment Detail.

Trench backfill replacing rock excavation shall be on-site select material or, if not available on-site, off-site select structural trench backfill. See Standard Detail 9.53.

3.17 DUST CONTROL

The contractor shall control dust throughout the life of the project within the project area and at all other areas affected by the construction of the project, including, but not specifically limited to, unpaved roads, haul roads, access roads, disposal sites, borrow and materials sources and production sites. Dust control shall not the considered effective where the amount of dust creates a potential or actual unsafe condition, public nuisance, or condition endangering the value, utility, or appearance of any property.

The contractor shall be required to sprinkle with water or to apply dust-allaying materials. Dust control is considered incidental and shall be carried out at the contractor's expense.

3.18 MATERIAL OWNERSHIP ELECTIVE

A. If the Town elects, all excess suitable material from excavation, which is not required for proper backfilling of the trenches, is the property of the Town of Wake Forest and such spoil shall be loaded and trucked by the Contractor to a designated dumping area as directed by the Town's Engineer. However, verify the Town's need and destination before bidding the project. If not stated elsewhere in the proposal, assume point of disposal is within a 5-mile radius of site of origin of excavation.

B. If the Town advises that they will not want the material, dispose of material in accordance with the requirements outlined elsewhere in these specifications. The cost of off-site disposal is to be included in the cost of excavation. No extra pay for off-site disposal of material.

C. Costs of disposal shall include all costs for permitting of waste site, erosion control, etc. as may be applicable in accordance with current laws in affect relating to waste disposal.

D. No payment for overhaul will be allowed under 2,500 feet.

E. A mining permit may be required.

3.19 CLEANUP AND RESTORATION OF SITE

A. During the progress of the work, the Contractor shall keep the premises and the vicinity of the work clear from unsightly and disorderly piles of debris. Suitable locations shall be specified for the various construction materials and for debris. The materials shall be kept in their storage locations, except as needed for the work and debris shall be promptly and regularly collected and deposited in the specified location.

B. Upon completion of section of pipeline and appurtenances, the Contractor shall fine grade the ground adjacent thereto, removing all surplus excavated material, leaving the area free from surface irregularities. He shall dispose of all surplus material, dirt, and rubbish from the site; and shall keep the site free of mud and dust to the satisfaction of the Town's Engineer. The contractor may be required to flush or sprinkle the street to prevent dust nuisance and/or sweep the street to remove mud or debris.

C. When working on the shoulders of paved roads, the Contractor shall keep the pavement clean of all loose earth, dust, mud, gravel, etc., and shall restore road surfaces, shoulders, and ditches as required by either the NCDOT or the right-of-way owner.

D. Grading Easements: Easements shall be graded to have cross slopes of 4% or less. The ground surfaces of easements shall be graded and cleared in such a way to promote proper drainage and allow mowing by vehicular equipment without damage to equipment from rock(s) and other debris.

E. After all work is completed, the contractor shall remove all tools and other equipment, leaving the site free, clean, and in good condition.

F. The contractor shall keep the surface over and along the trenches and other excavation in a safe and satisfactory condition during the progress of the work and for a period of one year after the work has been completed. He shall be held responsible for any accidents that may occur on the account of the defective condition of such surface.

G. No area shall be disturbed until an Erosion Control Permit has been obtained and a preconstruction conference conducted. Once the site has been stabilized, the Contractor shall remove all erosion control measures and stabilize disturbed areas as required by the approved plans/permit.

H. Work is only to be performed within a dedicated easement or right-of-way. No disturbance of private property shall be permitted without first obtaining written permission from the property owner.

3.20 SALVAGE OF USEABLE MATERIALS

All materials such as paving blocks, brick, castings, pipe etc., removed during excavation that is useable on this project shall be used after approval of its use by the Engineer. Such material shall be stockpiled on site. Unnecessary abuse and damage to these items shall be the Contractors responsibility and the cost of replacement deducted from the Contract. Any roadside driveway pipe in public or private streets belongs to the abutting property Towns.

End of Section 02210

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02400 - CONCRETE PAVEMENT, CURB & GUTTER, DRIVES, SIDEWALKS

(Last Revised 3/09/15)

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

PART 1- General
PART 2 – Products
PART 3 - Execution
Admixtures
C&G Control Joints
C&G Expansion Joints
Concrete
Concrete Class
Concrete Placement
Concrete Protection
Concrete Sidewalk Construction
Concrete Washouts
Coordination of Pours
Curb and Gutter
Curb Ramps (ADA)
Curing
Curing Materials
Defective Work
Finishing
Flumes & Ditches
Forms -Fixed
Forms-Machine Formed
Herbicides for Bikeways
Joint Sealer
Liquid Curing Agent
Reinforcing Steel
Retaining Walls
Testing
Weep Hole Pipe
Welded Wire Fabric
S/W & D/W Construction
S/W & D/W Control Joints
S/W & D/W Expansion Joints

PART 1 - GENERAL

1.1 GENERAL

A. The contractor shall furnish all labor, materials, tools, equipment, and perform all work and services necessary for or incidental to the construction of concrete pavement, curbing, sidewalks, and steps and other incidental structure as shown on drawings and as specified, in accordance with provisions of the contract documents, and completely coordinated with work of all other trades.

B. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including general and supplementary conditions apply to this specification.

B. Section 00825 – Product Substitutions

C. Section 02200 – Earthwork

D. Section 02210 – Trenching, Backfilling, And Compaction Of Utilities

E. Town of Wake Forest Pre-Approved Material/Product List

1.3 SUMMARY

This section includes concrete curbs, combination curb and gutters, ramps, sidewalks, driveways, flumes, valley gutters, median strips, islands, retaining walls, steps, and headwalls on municipal roadways and its appurtenances.

1.4 DEFINITIONS

A. **General**:

For the purposes of this specification, the following definitions refer to the streets and roadway system that comes under the authority of the Town of Wake Forest, North Carolina as specified within this section and other sections of this manual.

1) **Aggregate Base Course**: A layer of graded aggregate materials of a specified thickness placed between the subgrade and the concrete structure or appurtenance.

2) **Public Road System**: Roadway, streets, and their appurtenances required for the conveyance of the motoring public that are maintained by either the Town of Wake Forest or the North Carolina Department of Transportation.

3) **Subgrade**: The bottom surface of a sidewalk, curb and gutter or driveway shaped to conform to the typical section on which the concrete structure or appurtenance is constructed.

4) **Suitable Subgrade**: A subgrade that consists of a material type and density that is approved by the Town's Engineer for placement of a subsequent concrete structure or appurtenance.

B. The following are industry abbreviations for various materials and items:

1) **C&G**: Concrete Curb and Gutter

2) **D/W** Driveway

3) **S/W** Sidewalk

4) **WWF**: Welded Wire Fabric

1.5 SUBMITTALS

A. Submit product data, reports, and/or shop drawings, as applicable, for the following:

1) Air Entrainment
2) Concrete cylinder break tests
3) Concrete admixtures
4) Joint Sealants and expansion joint material
5) Curing compounds
6) Job mix formula
7) Other embedded items

1.6 QUALITY ASSURANCE

A. **Geotechnical Testing Agency Qualifications**: An independent testing agency qualified according to ASTM E329 to conduct soil materials and rock-definition testing as documented according to ASTM D3740 and ASTM E548.

B. Comply with all codes, laws, ordinances, and regulations of governmental authorities having jurisdiction over this part of the work.

C. The Contractor shall comply with North Carolina Department of Environment and Natural Resources, "Erosion and Sedimentation Control Handbook," latest revision.

D. Major requirements for concrete pavement, curb and gutter and sidewalk are set out hereinafter and on the drawings (See also the standard details in the Manual). Details not so set out or referenced shall conform to the following standards, which, along with their included references, are declared to be a part of this specification.

E. For convenience, reference is made in succeeding paragraphs to specific portions of various standards. Also, modifications and additions are made. Neither the reference nor the modifications are intended to de-emphasize any other portion of the standards.

F. It is the intent of this specification that whenever a procedure or technique is not called out herein, that the industry standard, as represented by ACI, ASTM or other appropriate recommendation, shall be used.

G. Materials and operations shall comply with the latest revision of the Codes and Standards listed below:

American Concrete Institute (ACI)

ACI 305	Recommended Practice for Hot Weather Concreting
ACI 306	Recommended Practice for Cold Weather Concreting
ACI 316	Specifications for Concrete Pavement and Concrete Bases
ACI 325	Recommended Practice for the Design of Concrete Pavements

American Society for Testing and Materials (ASTM).

ASTM A82	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A185	Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A497	Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A615	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM C150	Standard Specification for Portland Cement
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM C1116	Standard Specification for Fiber-Reinforced Concrete and Shotcrete
ASTM C1315	Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils (for classification purposes only)
ASTM D448	Standard Classification for Sizes of Aggregate for Road and Bridge Construction
ASTM D994	Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D3740	Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D4397	Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D5893	Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavement
ASTM E329	Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E548	Standard Guide for General Criteria Used for Evaluating Laboratory Competence
ASTM E1745	Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

American Association of State Highway & Transportation Officials (AASHTO)

AASHTO M144	Standard Specification for Calcium Chloride.
AASHTO M145	The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.
AASHTO M153	Standard Specification for Preformed Sponge Rubber and (ASTM D1752) Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
AASHTO M171	Standard Specification for Sheet Materials for Curing Concrete
AASHTO M213 (ASTM D1751)	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
AASHTO M224	Protective Coatings for Portland Cement Concrete
AASHTO T99	The Moisture-Density Relations of Soils using a 5.5-pound Rammer and a 12-inch drop
AASHTO T180	The Moisture Density Relations of Soils using a 10-pound Rammer and an 18-inch drop.
AASHTO T191	Density of Soil In-Place by the Sand-Cone Method
AASHTO T204	Density of Soil In-Place by the Drive Cylinder Method
AASHTO T205	Density of Soil In-Place by the Rubber-Balloon Method
AASHTO M284	Standard Specification for Epoxy-Coated Reinforcing Bars: Materials and Coating Requirements

1.7 STANDARD ABBREVIATIONS

ACI	American Concrete Institute
ADA/ABA	Americans with Disabilities Act and Architectural Barriers Act

ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
AASHTO	American Association of State Highway Transportation Officials.
ASTM	American Society for Testing and Materials
CRSI	Concrete Reinforcing Steel Institute
FS	Federal Specifications
MSDS	Material Safety Data Sheets
NCDOT	North Carolina Department of Transportation

Note: Designations such as ASTM, AASHTO, NCDOT, etc. referenced throughout this specification imply the latest revision.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

A. **Concrete Handling/Transportation**

1) Cement concrete plant operations shall comply with the applicable sections of NCDOT *Standard Specifications for Roads and Structures*, Section 1000, *Portland Cement Concrete Production and Delivery*.

2) Time limitations and intervals between deliveries shall be in accordance with Section 1000-4E, *Elapsed Time for Placing Concrete* of the NCDOT *Standard Specifications for Roads and Structures*.

3) See Part 3 - EXECUTION of these specifications for handling of materials during placement of hydraulic cement concrete.

B. **Steel Handling/Examination**:

1) **Steel Reinforcing Inspection**:

a. **Plain Steel Reinforcing**: Inspect materials thoroughly upon arrival. Examine materials for damage or excessive rust. Remove damaged or rejected materials from site. A light coat of rust is permitted to develop on steel bars and fabric; however, rust scaling and flaking is not permitted

b. **Coated Steel Reinforcing**: Handling and storage of coated bars shall conform to the requirements of AASHTO M284. Visible damage to the coating shall be patched or repaired with materials compatible to the existing coating in accordance with AASHTO M284.

2) **Pre-Installation Inspection**: Prior to being installed, inspect each bar of steel reinforcing for the presence of dirt, paint, oil, rust scaling, flaking or other foreign matter. Remove such matter with appropriate methods and to the satisfaction of the Town's Engineer.

C. Observe manufacturer's directions for delivery and storage of materials and accessories.

D. Reinforcing steel shall be stored on platforms, skids, or other supports that will keep the steel above ground, well drained, and protected against deformation. Upon delivery to site, epoxy coated steel shall be covered with an opaque covering. Coverings shall be placed to provide air circulation and prevent condensation.

1.9 PROJECT CONDITIONS

A. PROTECTION OF STREAMS

Do not discharge excess concrete into a drainage pipe, catch basin, ditch, stream, river, pond, or lake.

B. PROTECTION OF ROADWAYS

Do not discharge or allow concrete to spill onto any roadway or appurtenances either during placement or while in transit. Remove spills immediately or otherwise repair street as directed by the Town's Engineer.

C. PROTECTION FROM MARKING:

Newly poured concrete roads, streets, curbs, or sidewalks shall be protected AND guarded from graffiti from passersby until the concrete has sufficiently cured. Failure to prevent graffiti, or other such vandalism, shall result in the new concrete having to be removed and replaced. This requirement shall mandate the Contractor to take the necessary steps in preventing such incidents including, but not limited, to guarding the project after normal working hours.

D. WASHOUT HANDLING

A concrete washout shall be identified on approved construction plans. The area shall be maintained and restored prior to acceptance of the project.

1.10 COORDINATION

Coordinate placement of sidewalk and driveway connections to municipal streets and roadways with the Town's Engineer.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS

2.1.1 PORTLAND CEMENT CONCRETE

A. CONCRETE

Ready mixed concrete shall comply with ASTM C94, *Standard Specification for Ready-Mixed Concrete*. Cement concrete shall meet the requirements of Section 1000, *Portland Cement Concrete Production and Delivery* and Section 1024, *Materials for Portland Cement Concrete* of the NCDOT Standard Specifications for Roads and

Structures. Concrete strength shall be as specified on Standard Details and drawings. Unless otherwise specified, all concrete shall be Class A (3000 psi), minimum.

All exposed concrete shall be air entrained with an air content conforming to the requirements of Section 1000-4B, *Air Entrainment* of the NCDOT *Standard Specifications for Roads and Structures*. Air entrained admixtures for use in Portland cement concrete shall meet the requirements of AASHTO designation M-154, *Air-Entraining Admixtures for Concrete*. Only those admixtures shall be used which have been approved by the Town's Engineer.

If approved by the Town's Engineer, calcium chloride may be used as an admixture subject to the requirements of Section 1000-4H, *Use of Calcium Chloride* of the NCDOT *Standard Specifications for Roads and Structures*. Calcium chloride shall conform to AASHTO M144, Calcium Chloride, type 2. Do not use calcium chloride in reinforced concrete construction.

Concrete admixtures, when specified, shall conform to Section 1024-3, *Admixtures* of NCDOT *Standard Specifications for Roads and Structures*.

B. CONCRETE CLASS

1) Concrete Classes (NCDOT) to Design Compressive Strength at 28 days (f'c):

Class	Minimum Compressive Strength at 28 days (psi)
Class AA	4,500
Class A	3,000
Class B	2,500

2) Concrete class for combined curb and gutter, curbs, sidewalks, driveways, flumes, ditches, steps, headwalls, and islands shall be a minimum of Class A or as designated in the specifications or drawings. Machined formed curb shall be Class AA (4500 psi) unless otherwise permitted by the Town's Engineer.

2.1.2 HANDRAILS

Handrails shall conform to the applicable sections and requirements of Section 460, *Bridge Railing* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision. Handrails for trail projects shall comply with the applicable subsections of Section 1074, *Miscellaneous Metals and Hardware* of the NCDOT *Standard Specifications for Roads and Structures*.

2.1.3 JOINT FILLER

A. **PREFORMED EXPANSION JOINT FILLER**

Utilize preformed joint filler for expansion joint material as applicable for the type use. Material shall be approximately ½ inch in thickness and a width and depth equal to those of the incidental structure. However, unless otherwise directed by the Town's Engineer, install expansion joint filler 1/2-inch below the concrete surface and seal for maximum protection from water infiltration, weathering and to assure proper performance. See paragraph 2.1.4 for concrete joint sealer requirements.

1) **Asphalt Expansion Joint**: *Typically used in 80% of all control joint applications; the expansion joint material of choice.* This joint is *to be used in sidewalks, driveways and streets.* Expansion joint is composed of a blend of asphalt, vegetable fibers, and mineral fillers formed under heat and pressure between 2 asphalt-saturated liners. Joint material is waterproof, flexible, non-absorbing, self-sealing, and permanent and shall meet AASHTO M33, ASTM D994, and Federal Specification HH-F-341 F for thicknesses ½" through 1".

2) **Standard non-extruding cork (not for use in areas exposed to the weather)**: *Usually used where a constant friction fit is desired.* Cork bonded with phenolic resin, highly resilient, will compress without extrusion and recover to 95% of its original thickness after 50% compression (ASTM D1752, Type II; AASHTO M153, Type II).

3) **Self-expanding cork (not for use in areas exposed to the weather)**: *Usually used where high resiliency is needed such as in sewage plants, floodwalls, spillways, filtration plants and in commercial and industrial applications.* Compressed under heat and pressure to permit expansion to 140% of original thickness after installation, activated by humidity (ASTM D1752, Type III; AAHSTO M153, Type III).

4) **Sponge rubber**: *Frequently used on bridge structures and sewage treatment plants that undergo rapid changes in temperature. Used around pillars, drains, hydrants, lamp and signposts as well as in isolation applications or between materials having dissimilar coefficients of expansion.* Gray, non-absorbent, closed-cell, flexible and resilient, density of not less than 30 pcf (ASTM D1752, Type I; AAHSTO M153, Type I).

5) **Standard Asphalt Saturated Fiber**: *To be used in sidewalks, driveways and streets, commercial and industrial applications. Install ½" below the surface and seal joint with ASTM D3405 polymeric hot-applied sealant for maximum protection from water infiltration, weathering and to assure proper performance.* Cellular fibers bonded together and uniformly saturated with asphalt, resilient, flexible and non-extruding, when compressed to half of its original thickness, it will recover to a minimum of 70% of its original thickness, (ASTM D1751; AASHTO M213).

2.1.4 JOINT SEALERS

A. **Hot Applied Joint Sealant Compound For Concrete Pavements, Bridge, Curb And Gutter Joints, Crack And Joint Sealing Projects** (Non-pedestrian areas) (To be used on all Town or NCDOT projects): Premium quality hot applied joint sealer shall be a rubberized/asphalt product meeting ASTM D6690, *Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.* Hot applied Joint sealer is not to be used in areas of a heavy pedestrian traffic.

B. **Concrete Joint Sealant for Pedestrian Traffic Areas:** Use low modulus silicone sealant meeting ASTM D5893, *Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.*

C. **Concrete Joint Sealant Pedestrian Traffic And Driveway Joint Sealing Compound:** Two-part component cold applied urethane polymer modified with coal tar sealant,

self-leveling non-tack material meeting ASTM C920 *Standard Specification for Elastomeric Joint Sealant*, Type M, Grade P, Class 25, use T; Federal Spec SS-S-200, Type H, Federal Spec SS-S-195, Type H.

D. **Other Joint Sealant Materials:** Material shall meet the NCDOT Standard Specifications for Roads and Structure, Section 1028 *Joint Materials* for other acceptable joint sealer materials.

2.1.5 BOND BREAKERS AND BACKER RODS

A. **Bond Breakers and Backer Rods**: Material shall meet the NCDOT Standard Specifications for Roads and Structure, Section 1028 *Joint Materials* for bond breakers and backer rod material specifications.

2.1.6 CURING MATERIALS

A. Liquid membrane curing compound, PE film, burlap, or water for curing shall meet the requirements of Section 1026, *Curing Agents* of the NCDOT *Standard Specifications for Roads and Structures.*

B. **Liquid Curing Compound:** Liquid membrane forming compounds meeting ASTM C309; AASHTO M148, Type 2, white pigmented for Type ID, clear to translucent with fugitive dye.

C. **Sheeting Material For Curing Concrete:** Use sheeting material meeting AASHTO M171 *Standard Specification for Sheet Materials for Curing Concrete.*

2.1.7 INSULATION BLANKET

In cold weather operations, insulated blankets must retain or supply moisture and maintain the temperature at the outermost surfaces of concrete above 50° F for at least 72 hours and above 32° F for at least an additional 48 hours. For other measures pertaining to placing concrete in cold weather, see Section 420-7, *Placing Concrete in Cold Weather* of the NCDOT *Standard Specifications for Roads and Structures.*

2.1.8 WEEP HOLE PIPE

Material shall be minimum schedule 40 PVC pipe meeting ASTM D1785.

2.1.9 PORTLAND CEMENT

Type I, CSA normal, ASTM C150 *Standard Specification for Portland Cement.*

2.1.10 REINFORCING STEEL

A. **REINFORCING BARS**

Steel reinforcing bars shall be minimum grade 60 and shall conform to the requirements of AASHTO M31, *Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcing and ASTM A615.* Reinforcing bars shall also conform to the applicable requirements of Section 1070, *Reinforcing Steel*, of the NCDOT *Standard Specifications for Roads and Structures.*

B. **WELDED WIRE FABRIC**

Welded wire mesh shall be of the size specified by the Town's Engineer but shall be minimum 6 x 6, W2.9 x W2.9 and shall conform to the requirements of AASHTO M32, *Cold-Drawn Steel Wire for Concrete Reinforcement* and the applicable sections of Section 1070, *Reinforcing Steel* of NCDOT *Standard Specifications for Roads and Structures*.

2.1.11 CONCRETE ADMIXTURES

Concrete admixtures, when specified by the Town's Engineer, shall conform to Section 1024-3, *Admixtures* of NCDOT *Standard Specifications for Roads and Structures*.

PART 3 – EXECUTION

3.1 FORMS

3.1.1 FIXED FORMS

A. **Forms - Materials and Dimensions**: Provide metal side forms not less than 7/32 - inch thick, depth equal to edge thickness of concrete. Steel forms shall be used for the construction of curb and gutter. Fixed forms shall be straight, free from warp, and of such construction that there will be no interference with the inspection of grade and alignment. Metal templates, not more than 3/16 inch in thickness and manufactured in accordance with the curb and gutter section, shall be set in the places provided in the forms not more than 10 feet apart. Templates shall be adjusted to prevent short sections (less than 5 feet).

Radial forms shall be sufficiently flexible or otherwise designed to provide a smooth, uniform, curved surface of the required radius.

For special shapes that are difficult to form using the metal forms, flexible, curved or wood forms may be used as long as the form leaves a uniform face free from kinks, depressions, bends or protrusions.

B. **Form Support:** Forms shall extend the entire depth of the item and shall be braced and secured so that no deflection from alignment or grade will occur during concrete placement. Compact subgrade cut grade to support forms and superimposed machine loads. Use bearing stakes driven flush with bottom of form to supplement support as necessary. Do not use earth pedestals.

C. **Staking Forms:** Joints are to be neat and tight. Stake pin securely with at least 3 pins for each 10-foot section.

D. **Forming/Preparation:**

1) Use clean forms and oil forms prior to placement of concrete.

2) Set forms sufficiently in advance of work to permit proper inspection by the Town and to allow readjustment if required.

3) Previously finished pavement or curb and gutter, contiguous with new work, may serve as side form when approved by the Town's Engineer or his representative.

E. **Curb and Gutter – hand formed (Fixed Forms):**

1) **Templates/Jointing**: Curb and gutter metal templates, not more than 3/16 inch in thickness and manufactured in accordance with the curb and gutter section, shall be set in the places provided in the forms not more than 10 feet apart with expansion joints not more than 90 feet apart. Templates shall be adjusted to prevent short section (less than 5 feet).

2) **Subgrade Fine Grading**: When back and front forms have been set to exact grade and secured, the dividing plates shall be inserted and trued up. With these forms as templates, fine grading to exact sub-grade elevation shall be completed by hand. Face forms shall then be set. The Contractor shall, at all times, have at least one hundred feet (100) of forms set and grade tested and approved by the Engineer, ahead of pouring operations. He shall use every effort to observe any possible misalignments in grades and shall call such to the attention of the Town's Engineer or his representative promptly.

3) **Cross Section**: Unless otherwise noted on the plans, curb and gutter shall be of the vertical curb type, conforming to the dimensions shown in the standard details except where a 30 inch valley curb is used. See Standard Detail 9.02.

4) **Termination of Curb and Gutter**: All concrete pours shall terminate at a template. If pouring is to be resumed within one hour or less, any excess concrete that exists after the template has been reached may be spread in the bottom 2 inches of the gutter form adjoining the completed curb or either the concrete is to be discarded from the forms.

3.1.2 CURB AND GUTTER- SLIP (MACHINE) FORMED (PREFERRED OVER HAND FORMED):

A. **Equipment**: The slipform equipment shall be self-propelled and shall be equipped to consolidate, form, extrude, and finish the freshly placed concrete in such a manner that a minimum of hand finishing is required to produce a dense, consolidated, homogenous product. Slipform equipment shall be controlled to line and grade by automatic sensing, guidance, and control devices such that the machine automatically senses and follows taut guidelines or other stable reference, performing any necessary corrective action to ensure the correct grade and alignment is achieved.

The Contractor shall plan and stage the work to eliminate the need for the slipform machine to be stopped during placement operations.

B. **Attachments**: The forms on the equipment must meet the precise dimensions shown on Standard Detail 9.02 for the different types of curb. A sufficient number of vibrators shall be provided on the machine and be in good working order.

C. **Line and Grade Controls**: It shall be the Contractor's responsibility to set the line and grade controls for his machine. These controls shall be checked by the Town's Contractor before any "trimming" or pouring occurs. However, approval of these controls by the Town's Contractor shall not relieve the Contractor of the

responsibility of obtaining the planned grade or alignment according to the construction stakes.

D. **Subgrade Trimming**: It shall be the responsibility of the Contractor to ensure that the subgrade conforms to the Standard Details. No extra payment shall be made to the Contractor for "trimming" the subgrade if such "trimming" is less than the 6-inch limit allowed for unclassified excavation as defined in Section 02200, *Earthwork*. Before pouring operations begin, the subgrade shall be checked by the Town's Contractor.

E. **Concrete Placing Operations**: Before the machine starts a pour, the slump of the concrete will be checked in the presence of the Town's Contractor. This slump must be between 0 and 2 inches. In the event that the slump exceeds 2 inches, the concrete will be rejected.

If it is determined by the Town's Contractor that the poured curb or gutter does not meet the exact dimensions of the "standard drawings" or for some other reason it does not conform to these specifications, (alignment, grade, materials, etc.) then the Contractor, at his own expense, shall remove the faulty work before concrete obtains full set. No compensation shall be made for unsatisfactory work.

The Contractor shall make sure that sufficient vibration of the concrete occurs. If vibrators fail to function, all operations shall cease until they are satisfactorily repaired.

Where storm inlets are designated, the Contractor shall either leave a sufficient blank space to be hand formed later or work concrete to the exact dimensions for the standard inlet specified.

F. Scoring/Expansion Jointing: Provide scoring at 15-ft intervals. Expansion joints are to be provided at a minimum of 90-ft intervals.

G. **Defective Curb & Gutter**: Honeycombed concrete shall be filled with a sand/cement paste and allowed to cure prior to backfilling curb. If in the opinion of the Town's Engineer the honeycombing, blemish or damage by construction equipment is extensive to the point of rendering a weak, cracked or otherwise questionable section of curb, in strength or appearance, the Town's Engineer will require the curb section to be replaced at the Contractor's expense. See also paragraph 3.4.13, below.

H. **Excessive grout**: The use of excessive grout along the curb and gutter section will not be tolerated. The use of "mules" shall be limited to obtaining the desired finish - they should not be allowed to alter the section of the curb or unnecessarily work moisture to the surface. No floating and little to no troweling should be necessary against the curb face in order to obtain a true and proper section. The section should be obtained with the curb face form board.

3.1.3 JOINING CATCH BASINS

A. **Curb Opening Inlet – Curb Construction**: At all curb opening inlet type catch basins, there will be a short section of gutter in front of the curb opening inlet – the curb being replaced by the casting. The catch basin casting shall be parallel to and on the grade with the back form of the curb and gutter with the casting face extending 6 inches toward the pavement. The gutter area shall be so shaped and sloped as to

increase in slope toward the curbing to an extent that when opposite the catch basin casting, it will provide a 6 inches clear opening below the inside of the casting top. This warped section at, and adjacent to, each catch basin shall have the exact same finish texture as that of the other curbing present and shall be poured at the same time, where possible. A double ply of 30-pound building felt shall be inserted on all sides of casting covers that come in contact with any concrete.

3.2 CURB & GUTTER JOINTS

3.2.1 CURB & GUTTER - CONSTRUCTION/CONTRACTION JOINTS

A. **General:** Provide joints of various types as called for on drawings or required here in these specifications. Hold location and alignment to within plus or minus 1/4 inch. Finish concrete surface adjacent to a previously placed slab to within plus or minus 1/8 inch, with tooled radius of 1/4 inch.

B. **Construction (Cold) Joints, Control Joints/Contraction Joints** (transverse jointing):

1) Provide transverse control/contraction joints for crack control for fixed forms at the following locations:

a. Locate joints as shown on the plans or standard details, except as provided herein.

b. At approximately 15 foot intervals.

c. Space joints no closer than 5 feet.

d. At the gutter where the curb and gutter ties to the gutter apron of drop inlets;

e. Locate joints to line up with joints in concrete pavement when placed adjacent to concrete pavement.

f. When time elapsing between consecutive concrete placements exceeds 45 minutes, and

2) Transverse joints for crack control may be formed by using one of the following methods:

a. Removable templates.

b. **Tooled or Formed Groove Joints (hand formed or machine formed C&G)**: Form groove in freshly placed concrete with tooling device specifically constructed for this purpose. Groove dimensions shall be 3/8 inch at surface and 1/4 inch at root. Score depth for non-template formed joints shall be a minimum of 1 ½ inches deep (1/4 of concrete depth). If formed by a tool is used, make a radius of 1/8" at the corner of the adjacent concrete.

c. **Sawed Joints**: Saw ¼-inch groove in green concrete. Commence sawing as soon as concrete is hard enough to withstand sawing operation without chipping, spalling, tearing, or dislodging aggregate regardless of the time of day or weather but not more than 24 hours after the concrete has been placed.

Thoroughly wet surface to protect membrane cure and re-coat afterward. Complete saw cutting before shrinkage stresses cause cracking.

d. Leave-In Type Joints: In lieu of sawed or tooled joints, approved "leave-in" type insert may be employed. Leave-in type joints to be placed in concrete prior to pour.

e. Joints may be formed or created using other approved methods approved by the Town's Engineer that will successfully induce and control the location and shape of the transverse cracks.

3) **Template Removal**: If templates are used for transverse joints, templates shall be removed by stages, but not entirely until the concrete has become thoroughly hard. After removal of the templates, there must be a clear division throughout between these sections. Edging tools will be used to form an edge along the back and front form and at each template.

4) **Control Joints/Contraction Joints Joint Sealing:**

a. Thoroughly clean the joint to remove all foreign matter. Dry joints before sealing. Entirely fill joint to within 1/8- to 1/4-inch of the surface of the concrete with joint sealer. Immediately remove any sealer spilled on the surface of the concrete.

b. Fill joints in gutter with joint sealer to top surface of gutter.

c. Seal all joints except for joints in curb sections not having an integral gutter. This includes tooled or sawed joints.

d. Place joint sealant in cracks after removal of templates.

e. Joints are to be sealed before backfilling or performing adjacent operations.

a. See paragraph 2.1.4, Joint Sealers for material spec.

3.2.2 CURB & GUTTER - EXPANSION JOINTS:

A. On non-reinforced or non-load transferring expansion joints, insert and attach expansion joint material to either the form or the existing concrete.

B. Cut the filler into the same shape and size as the area to be covered except cut it ½-inch below any surface that is exposed to view in the finished work. As an option, cut the cut the filler the same size and shape as that of the adjoining surfaces and cut back the material 1/2-inch on the surface that are exposed to view after the concrete hardens. Cut the filler out of as few pieces as practicable and, except as noted above, completely fill the space provided. Fasten the pieces in any one joint together in an approved manner. Do not use loose fitting or open joints between section of filler or between filler and forms. Place 2-ply roofing felt over all joints in the filler material in vertical expansion joints below top of curbs. Place the felt on the side of the joint adjacent to the new pour.

Use an optional second layer to obtain the required thickness, when a thickness of more than 1-inch is required.

C. Select type of preformed expansion joint filler to match use. See Section 2 – PRODUCTS of these specifications for approved expansion materials.

D. At load-transferring expansion joints, stake joint material in place as well as space and support load transfer devices (which usually consist of dowels) as called for on the plans.

E. Provide expansion joints at the following locations/intervals:

1) Expansion joints shall be formed at intervals of approximately 90 feet on centers,

2) At all radii PC or PT points at concrete entrances and curb returns,

3) At locations no less than 3 feet and no more than 10 feet from drop inlets,

F. **Expansion Joint Sealing:**

1) Thoroughly clean the joint to remove all foreign matter. Dry joints before sealing.

2) Entirely fill joint to within 1/8- to 1/4-inch of the surface of the concrete with joint sealer. Immediately remove any sealer spilled on the surface of the concrete.

3) Joints are to be sealed before backfilling or performing adjacent operations.

4) See paragraph 2.1.4, Joint Sealers for material spec.

3.3 CONCRETE SIDEWALK AND DRIVEWAY ENTRANCES - JOINTS

3.3.1 CONTROL/CONSTRUCTION JOINTS:

A. Control/Construction Joints may be formed by any of the methods specified above for Concrete Curb & Gutter.

B. Provide control/construction joints for crack control at the following locations:

1) Locate joints as shown on the plans or standard details, except as provided herein.

2) At approximately 5 foot intervals. Typically, the slab between expansion joints shall be divided into equal sections of not more than 5 feet.

3) Where slabs are more than 7 feet in width, the Town's Engineer may require that scored control joints be formed longitudinally to obtain uniform blocks that are approximately square.

4) Transverse control joints shall also be installed where the corners of the drop inlets project into the sidewalk.

5) When time elapsing between consecutive concrete placements exceeds 45 minutes.

C. Control/Construction joints shall be laid out is such a manner as to be placed radial to curves. Do not run joints such that they create oblique or sharp angles along edges of concrete work.

D. Control joints shall extend into concrete for at least 1/4 of the depth (e.g 1 inch for 4-inch concrete sidewalk) and shall be approximately 1/8 inch in width.

E. Keyway Joints: Install permanent joint strips (which are to be left in place). Stake and support like side form. Provide dowels or tie bars, if called for on plans.

F. Score joints formed by a jointing tool, trowel, or other approved means.

3.3.2 EXPANSION JOINTS:

A. Provide expansion joints for at the following locations:

1) Sidewalk expansion joints shall be installed every 30 linear feet of sidewalk, where sidewalk abuts existing curbs, pavements, a structure or as directed by the Town's Engineer.

2) Concrete flat work expansion joints shall be placed where concrete abuts against a structure, curb & gutter, manholes, or as otherwise directed by the Town's Engineer. Expansion joints shall also be formed around appurtenances extending into and through the sidewalk.

3) Preformed expansion joints shall also be installed between concrete sidewalk and any adjacent fixed structure which is not tied to the sidewalk with steel dowels.

B. Slabs shall be separated by transverse preformed joint filler 1/2 inch in thickness that extends from the bottom of the slab to approximately 1/4 inch below the top surface. An expansion joint shall be formed and filled with a minimum 1/2 inch thick preformed joint filler.

C. See Section 2 – PRODUCTS of these specifications for approved expansion joint material.

D. Joint Sealant: Seal control/Construction joints and expansion joints as outlined above for Curb and Gutter. See paragraph 2.1.4, Joint Sealers for material specification for pedestrian traffic use.

3.4 CONSTRUCTION – ALL CONCRETE ITEMS

3.4.1 CONSTRUCTION OF SUBGRADE

A. **Subgrade Preparation**: Excavation and subgrade preparation shall be in strict compliance with Section 02200, *Earthwork*. The subgrade upon which this work is to be placed shall be shaped and compacted to a firm, even surface conforming to the elevation and cross-sections shown on the plans, the standard drawings, or as directed by the Engineer. All soft, frozen, and unsuitable material shall be removed and replaced with approved material. The subgrade shall be moist when the concrete is placed.

B. **Bicycle/Greenway Subgrade**:

1) Pavement subgrade should be prepared in accordance with paragraph 3.1.1 A, above and shall conform to the grade and cross-section shown on the plans.

2) Herbicides shall conform to Section 1060-13, *Herbicides* of the NCDOT Specifications for Roads and Structures, latest revision shall be applied to the aggregate base course and/or subgrade immediately prior to paving. The rate of application shall be as recommended by the herbicide manufacturer. ***Herbicides shall not be left uncovered for longer than 15 minutes***. Herbicides shall not be used where they may contaminate water used for irrigation or drinking purposes.

C. **Subgrade Fine Grading (Trimming)**: When forms have been set to exact grade and secured, fine grading to exact sub-grade elevation shall be completed by hand. Before pouring operations begin, the Contractor shall have forms set and grade tested and approved by the Contractor ahead of pouring operations. Subgrade fine grading shall be the responsibility of the Contractor to ensure that the subgrade conforms to the Standard Details.

3.4.2 PLACING– ALL CONCRETE ITEMS

The concrete shall be placed in the forms in such a manner as to prevent the segregation of the mortar and the aggregate. The concrete shall be spaded, tamped, or vibrated sufficiently to bring the mortar to the surface. Concrete shall not be dropped a distance of more than 5 feet.

Prior to and during concrete placement, the Contractor's foreman or formsetter shall carefully watch all alignment and grades to detect any errors in grade or misalignment. In the event any of the work is damaged from any cause or prove defective in any way, or is out of alignment or grade, the Contractor shall remove such work and replace at his own expense. The detection of poor subgrade shall also be his responsibility.

When sufficient concrete has been placed in the forms, it shall be well spaded along all areas in contact with the forms in order to eliminate all honeycombing. Mix shall be rodded or vibrated to eliminate voids. Concrete shall be floated to the proper grade and alignment, free from depressions or other irregularities, after which the exposed surfaces shall then be screeded with a straight edge and finished with a steel or wooden trowel. The concrete shall be troweled smooth and, before the concrete obtains full set, very lightly brushed with a brush moistened with clear water. No mortar shall be used in the finishing. Immediately following finishing operations, the finished concrete shall be cured and protected in accordance with these specifications.

3.4.3 CURB AND GUTTER:

A. **Material, Grade and alignment**: Concrete for curb and gutters, curb returns, gutters and driveway gutters shall be 3000 psi 28 days (Class A – see paragraph 2.1.1.B), air entrained concrete. The alignment and grade of the curb and gutters will be established by means of offset stakes, and the completed work shall accordingly conform thereto. The Contractor's foreman or formsetter shall carefully watch all alignment and grades to detect any errors in grade or misalignment. In the event any of the curbs and gutters are damaged from any cause or prove defective in any way, or are out of alignment or grade, the Contractor shall remove such sections and replace at his own expense. The detection of poor subgrade for curb and gutter shall be his responsibility.

B. **Excavation and subgrade preparation:** Prior to placement of curb & gutter, a proof-roll inspection of the subgrade under the proposed curb & gutter shall be witnessed by the Town of Wake Forest or a Geotechnical Engineer. Proof rolling shall be performed by using a fully loaded tandem (25 ton gross vehicle weight) dump truck or tri-axle with the third axle up. Water tankers or other similar equipment will not be allowed. Areas, which do not pass the initial inspection, shall be repaired in accordance with section 02200 and re-inspected.

C. **Placing and finishing**: When sufficient concrete has been placed in the forms, it shall be well spaded along all areas in contact with the forms in order to eliminate all honeycombing. The concrete shall be floated to the proper alignment and grade, after which it shall be trowelled smooth and very lightly brushed. Face forms shall be removed as soon as concrete has attained sufficient set for the curb to stand without slumping. Templates shall be removed by stages, but not entirely until the concrete has become thoroughly hard. After removal of the templates, there must be a clear division throughout between these sections. Edging tools will be used to form an edge along the back and front form and at each template. The exposed surface shall then be smoothed by the use of a suitable finishing tool.

D. **Backfilling of Curb and Gutter**: Backfilling of Curb and gutter shall be in strict compliance with the specifications as stated in section 02200, Earthwork.

E. **Dressing Up**: After the curb and gutter and adjacent paving has been completed, that area between the curb and sidewalk shall be cleared of all construction debris and neatly graded.

F. **Curb and Gutter Replacement**: The Town will require the removal and replacement of the curb & gutter where it has been broken, cracked, excessively chipped or has become misaligned. Such areas designated by the Town's Engineer shall be repaired at no cost to the Town. Curb and gutter replaced shall conform to that now in place adjacent to the repaired area, as to section and shall conform to the requirements for new work as to strength and construction. When curb & gutter has been replaced, no section less than 5 feet in length shall result.

G. **Measurement**: Measurement of curb and gutter shall be by actual linear feet of curb and gutter installed measured at the bottom of the face of the curb, including that area across catch basins.

Where driveways occur, the curb and gutter measurement shall continue **across** the driveways, and that area from a line drawn 1-foot behind the face of the curb extended, or the gutter line, shall be paid for as curb and gutter. The remaining concrete in the driveway, between 4 feet back of the face of the curb and that line, shall be paid for as 6-inch concrete at the price bid in the proposal. See Standard Detail 9.08 for a clearer understanding.

H. **Payment**: The quantity of combination curb and gutter, measured as herein before specified, will be paid for at the contract unit price for the cross-section shown on the drawings. The price paid per linear foot for combination curbs and gutters shall include full compensation for furnishing all labor, materials, tools, and equipment, and doing all work involved in excavation, backfilling, and preparing the sub-grade for these structures and constructing the combination curb and gutter complete, in place, as herein before specified, including furnishing and placing all expansion-joint filler, and joint sealing compound. Valley gutters shall be paid on a linear footage

basis **at the same unit price as curb and gutter**. No pay item for handicap ramp depressions in curb. Handicap access ramps are to be paid by the square yard of concrete for the prescribed thickness noted either on the plans or in the standard details.

3.4.4 SIDEWALKS, DRIVEWAYS

A. **Material, Grade and alignment**: Concrete for sidewalks and driveways shall be 3000 psi at 28 days (Class A – see paragraph 2.1.1.B), air entrained concrete. The alignment and grade of sidewalks will be established as shown on the drawings or otherwise indicated in the standard details. Typically, the alignment and grade of the sidewalks will be determined from the previously placed concrete curb and gutter (see Standard Detail 9.11) but can vary depending on whether the curb is located either upgrade or downgrade depending on location of driveway aprons (see Standard Details 9.08). Typical sections can be deviated from only when approved by the Town's Engineer or his representative. Driveways shall connect the openings in the curb and gutter and extend across to the back edge of the sidewalks as shown on the drawings (see Standard Detail 9.08). In the event any of the sidewalks or driveways are damaged from any cause, or prove defective in any way, or are out of alignment or proper grade, the Contractor shall remove such sections and replace at his own expense.

B. **Construction of Sidewalks and Driveways**: After the forms have been set, check the sub-grade for proper compaction before allowing any concrete to be placed. Forms and subgrade will be inspected by the Town of Wake Forest prior to placement of concrete. All materials incorporated in this concrete shall conform to the provision as set out herein before and shall be mixed and deposited in accordance with the requirements of these specifications. Sidewalks shall be "scored" at five (5) foot intervals (see paragraph 3.3, Concrete Sidewalk and Driveway Entrances – Joints). If sidewalk is greater than six feet in width, scoring shall be as directed by the Engineer. All "scores" shall be straight and rounded at the surface with the proper edging tool, or as directed by the Town's Engineer. Outside edges of the sidewalk slab and joints shall be edged with an edging tool having a radius of 1/4 inch.

   The Town will require the removal and replacement of sidewalks and driveways that have been broken, cracked, excessively chipped or misaligned. Such areas designated by the Town's Engineer shall be repaired at no cost to the Town. Sidewalks and driveways replaced shall conform to that now in place adjacent to the repaired area, as to section and shall conform to the requirements for new work as to strength and construction.

C. **Sidewalk Expansion Joints:** Sidewalk expansion joints shall be installed every 30 linear feet of sidewalk, where sidewalk abuts existing curbs, pavements, driveways, a structure (such as a manhole or junction box) or as directed by the Town's Engineer. See paragraph 3.3.2, Expansion Joints).

D. **Excavation and Sub-Grade Preparation**: Excavation and sub-grade preparation for concrete sidewalks and driveways shall be in strict compliance with the specifications as stated in section 02200, Earthwork.

E. **Placing**: Concrete placement shall terminate at a template. If concrete placement is to be resumed within one hour or less, any excess concrete that exists after the template has been reached may be spread in the bottom two (2) inches of the adjoining sidewalk section, or disposed of as directed by the Engineer.

F. **Measurement:** Unless otherwise shown in the proposal, concrete sidewalks and driveways shall be measured by area in square yards.. The measurement of 4-inch concrete sidewalk shall be by actual field measurement and shall not include that portion of 6-inch concrete where driveways cut across the sidewalk area. This area shall be measured as 6-inch concrete driveway as applicable.

G. **Payment**: The quantity of 4 inch sidewalk and 6 inch driveways measured as herein before specified will be paid for at the applicable contract unit price. The price per square yard shall include full compensation for furnishing all labor, materials, tools, and equipment and doing all work involved in excavating, backfill, and preparation of the sub-grade for sidewalks and driveways, and construction sidewalks and driveways complete, in place, as herein before specified. Brick walks, driveways, or steps shall be paid for by the square foot.

3.4.5 CURB RAMPS (ADA)

The ramps shall be constructed as shown on the Town's Standard Detail drawings for the type shown on the plans or as directed by the Town's Engineer to meet ADA/ABA requirements.

3.4.6 PORTLAND CEMENT CONCRETE RETAINING WALLS, HEADWALLS, STEPS, PIERS FOR STREAM CROSSINGS, FLUMES AND DITCHES, MEDIAN BARRIERS, MEDIAN STRIPS, ISLANDS, ETC.

A. **General Requirements**

This work shall consist of Portland cement concrete retaining walls, headwalls, steps, piers for stream crossings, flumes and ditches, median barriers, median strips, islands, etc. constructed in accordance with these specifications. These structures shall be constructed to the dimensions, cross-section, and located as shown on the plans, shown on the Standard Details, or as directed by the Town's Engineer.

B. **Reinforcing Steel**

Reinforcement steel shall be placed in accordance with the drawings, the Concrete Reinforcing Steel Institute's *Placing Reinforcing Bars Recommended Practices,* the latest edition of ACI 318, *Building Code Requirements for Reinforced Concrete,* latest edition and Section 425, *Fabricating and Placing Reinforcement* of the NCDOT *Standard Specifications for Roads and structures*. See also paragraph 2.1.10, *Reinforcing Steel* of this specification.

C. **Handrails**

Handrails shall be placed in accordance with Section 1074, *Miscellaneous Metals and Hardware* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision.

D. **Flumes And Ditches**

Concrete flumes and ditches shall be constructed in accordance with Section 850, *Concrete Paved Ditch* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision.

E. **Median Barriers, Median Strips And Islands**

Concrete median barriers, median strips, and islands shall be constructed in accordance with Section 852, *Traffic Islands and Medians* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision.

F. **Piers For Stream Crossings, Steps, Headwalls And Retaining Walls**

Concrete retaining walls shall be constructed in accordance with Sections 420, *Concrete Structures* of the NCDOT *Standard Specifications for Roads and Structures.*

3.4.7 CONCRETE PLACEMENT COORDINATION

It will be the responsibility of the Contractor to coordinate the times of pours with the Inspector. Sufficient notice shall be given to the Inspector so that he/she can check all aspects of the work before the pouring operations begin. Under no circumstances shall the Contractor pour concrete until the Inspector has had sufficient time to make checks of the work. An inspection shall be requested at least 24 hours prior to any concrete placement.

The maximum interval between the placing of batches at the work site shall not exceed 20 minutes. See also Section 1000-4E, *Elapsed Time for Placing Concrete* and Table 1000-2 of the NCDOT *Standard Specifications for Roads and Structures.*

3.4.8 FINISHING

A. **General**: As soon as concrete is placed, strike off and screed to crown and cross section, slightly above grade so that consolidation and finishing will bring to final drawing elevations. Maintain uniform ridge full width with first pass of first screed.

B. **Pavement, Curb and Gutter and Similar Surfaces.**

1) Consolidate by vibrating screeds, internal units or a combination

2) Float by longitudinally reciprocating float, passing gradually from edge to edge. Ensure successive advances do not exceed half the length of the float.

3) Test level of slab with minimum 10-foot straightedge. Fill depressions with fresh material, consolidate and refinish. Cut down high areas and retest.

4) Belt surface with 2-ply canvas belt, using transverse strokes while advancing along centerline.

5) Provide final finish by full width burlap or carpet drag, drawn longitudinally. Keep drag clean to avoid build up and consequent scarring.

6) Tool pavement edges with suitable edger.

7) Retest with straightedge. If pavement shows deviation of more than 1/8 inch in 10 feet remove and replace.

C. **Sidewalk, Steps, Ramps, And Similar Surfaces.**

1) Consolidate by vibrating screeds, internal units or a combination.

2) Test with 6-foot straight edges equipped with long handles and operated from off the sidewalk. Draw excess water and laitance off from surface.

3) Float finish so as to leave no disfiguring marks but to produce a uniform granular or sandy texture.

4) Tool pavement edges with suitable edger.

3.4.9 CURING

A. **Curing – Year Around**

Curing shall be accomplished by preventing loss of moisture, rapid temperature change, and mechanical injury from rain or flowing water for a period of 3 days when normal Portland cement has been used or 7 days when pozzolan mix designs are used. Curing shall be started as soon as placing, finishing, and free water has disappeared from the surface of the concrete. One of the following methods of curing are required year round:

1) **Liquid membrane compound**: Apply membrane–curing compound for curing, sealing, and moisture retention. The entire exposed surface of the structure shall be sprayed uniformly with a white pigmented membrane-forming compound (see paragraph 2.1.6.B, above) immediately following the texturing operation. The curing compound shall be applied in 2 coats by hand.

   Do not expose newly placed concrete for more than 30 minutes before being covered with curing compound. Failure to cover the surfaces of the concrete shall be cause for immediate suspension of the paving operations.

   Perform application in accordance with manufacturer's directions but at a minimum rate of 100 to 150 square feet per gallon and not more than 350 square feet per gallon (total for both coats). Application shall be by a sprayer or long-nap roller and shall be an even, continuous membrane produced on the concrete surface. The second coat shall be applied in a direction approximately at right angles to the direction of the first coat. No puddling shall be produced. At the time of use, the compound shall be in a thoroughly mixed condition, with pigment uniformly dispersed through the vehicle. The compound shall form a uniform, continuous, coherent film that will not check, crack or peel and shall be free from pinholes or other imperfections.

   The membrane shall harden 30 minutes after application. Personnel and equipment shall be kept off the freshly applied material to prevent damage to the seal. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected for 7 days from pedestrian and vehicular traffic and from any other action that might disrupt the continuity of the membrane. If the membrane becomes damaged within the initial 72 hours, damaged portions shall be repaired immediately with additional compound.

   If removal of forms is required, exposed sections shall be protected immediately to provide a curing treatment equal to that provided for the surface.

2) **PE Film**: Spread the section of the film in a manner that will not damage the finished pavement surface. Securely tape or provide lap joints for the sections that are at least 12 inches wide and take suitable precautions to prevent the circulation of air beneath the film. Use black or dark plastic sheets when the daily high ambient temperature is between 40°F - 60°F. Use white opaque reflective plastic sheet when the daily ambient temperature is above 60°F. Plastic sheets shall meet the requirements of ASTM C171, *Standard Specification for Sheet Materials for Curing Concrete*.

   Check the film for damage when it is spread and during the curing period. Repair or replace any damaged section immediately.

B. **Cold Weather Concreting:**

1) **Concrete temperature**: Concrete with a temperature of less than 55 degrees F will not be allowed to be placed. For coldweather concreting, comply with the requirements of ACI 306R, latest revision.

2) Concrete Temperature: Conform to the requirements of paragraph 420-7, Placing Concrete in Cold Weather of the NCDOT Standard Specifications for Roads and Structures, for the required temperatures of concrete.

3) **Cold subgrade**: No concrete is to be placed on a frozen subgrade.

4) **Rate of Temperature Change**: Keep changes in temperature of air immediately adjacent to concrete, during and immediately following curing period, as uniform as possible. Do not exceed a temperature change of 5 degrees F in any 1-hour or 50 degrees F in any 24-hour period.

5) **Curing – Normal Air Temperature Range: 40 to 85 degrees F**: Use liquid curing compound.

6) **Curing – Abnormal Air Temperature Range: Less than 40 degrees F**: No concrete is to be poured when the outside temperature is 40 degrees and falling unless measures are taken to insulate the concrete and otherwise protect the concrete for at least 3 days after the pour from freezing.

7) In cold weather applications, calcium chloride may be used as an admixture, if approved by the Town's Engineer, provided the concrete is not reinforced.

C. **Hot weather concreting:**

1) **Curing – Abnormal Air Temperature Range: Above 80 degrees F**:

   a) When the outdoor temperature rises above 85 degrees F, comply with ACI 305R, latest amendment.

   b) Verify proposed methods of proposed protection with the Town's Engineer before pouring concrete during high temperatures.

   c) Routine hot weather measures: Routine measures for hot weather are cooling forms and wetting subgrade in addition to any of the other measures that may be employed to protect the concrete.

d) Other measures for reducing temperature in concrete to aid in curing: Windbreaks, shading, fog spraying, sprinkling, ponding or wet covering with an approved light colored material.

e) Take such protective measure as quickly as concrete hardening and finishing operations will allow.

f) Set retarder: With the permission of the Town's Engineer, consider using set retarder admixtures along with curing compound.

g) Cooling ready mix concrete: To reduce temperature during mixing, add ice into mix at plant. If trees are available, park waiting trucks in shade.

3.4.10 PAVEMENT PATCHING:

Where pavement patching is necessary, ensure work complies with following requirements.

A. Pavement repair is to comply with Standard Detail 9.06.

B. Place pavement patch providing a thickened edge. Ensure that patch in plane of "cold" joint has a thickness 6 inches greater than that of the existing pavement. Extend patch under existing pavement for a distance of no less than 6 inches. Fill void under existing pavement full of concrete.

C. Undercut existing pavement 6 inches all around patch and to a depth of 6 inches.

D. Prior to placing patch, saw cut edge of existing pavement to 1/4 depth and remove pavement to provide a vertical face for a straight and true joint.

E. Patch pavement as detailed and specified with concrete materials specified in this pavement section or as shown on drawings.

3.4.11 PROTECTION OF CONCRETE

A. Protect new concrete sidewalks and appurtenances from pedestrian traffic for a minimum of 24 hours and do not open to pedestrian traffic for the first 5 days. Vehicular traffic shall be excluded for the first 14 days or until the minimum design compressive strength is attained, whichever is the lesser time.

Protect new concrete driveway surfaces and curb and gutter from vehicular traffic for minimum of 7 days or until the minimum design compressive strength is attained, whichever is the lesser time, unless otherwise approved by the Town's Engineer. Erect and maintain warning signs, lights, and watchmen to protect pedestrian and to direct traffic as needed.

B. Repair or replace parts of pavement damaged by traffic or other causes occurring prior to final acceptance. Protect concrete pavement against public traffic, construction traffic and traffic caused by employees and agents.

C. No equipment shall be driven or moved across newly paved surface unless such equipment is rubber-tired and only if paved surface is designed for and capable if sustaining loads to be imposed by the equipment.

D. Do not drive over new or existing paved surfaces with tracked vehicles and equipment.

E. Protect concrete from graffiti.

3.4.12 TESTING

A. Testing

1) **Initial Test**: The initial test (from first ready mix truck) is to be taken after the second yard is dispatched from the mixer and is to consist of the following:

a. One slump test

Table 2400.1	
APPLICATION	ALLOWABLE SLUMP
Hand poured Curb and Gutter	2" to 3 ½"
Machine formed Curb and Gutter	0-2" (see paragraph 3.1.2.E)
Other Applications	as specified by Town's Engineer

b. Pull, prepare and store 3 cylinders on-site for 24 hours

c. Temperature

2) **Second Test:**
After the above tests are pulled from the initial truck, every 5th truck thereafter is to be tested in the same manner as noted above.

3) **Subsequent Tests**: Slump tests may be required at any time during the pour if for any reason the Town Representative or Contractor feels the conditions of the concrete have changed. If the slump test fails, test cylinders of that section shall be taken by the Contractor.

4) The Engineer shall require any concrete that fails to meet the required compressive strength to be removed from any portion of a sidewalk, curb & gutter or driveway and that it be replaced at the contractor's expense.

5) **Testing Costs**: The cost of Quality Control (QC) tests, tests to assure the Contractor that he/she is meeting and complying with the requirements of these specifications, is the Contractor's responsibility. The cost of Quality Assurance (QA) tests, tests performed independently by the Town of Wake Forest to confirm that the Contractor is generally performing his/her work in compliance with these specifications, is the responsibility of the Town of Wake Forest.

3.4.13 DEFECTIVE WORK

The Town will require the removal and replacement of any concrete items where there are structural cracks, the concrete element has broken, has chips marring the appearance or mating of materials, have become misaligned, grades are incorrect, does not meet dimensions as shown in the Standard Details, improperly cured, or of a substandard or non-approved product. Such areas designated by the Town's Engineer shall be repaired at no cost to the Town. Items replaced shall conform to the

requirements for new work as to strength and construction. During removal of defective work, an amount equal to the required lengths of construction joints must be removed and replaced.

Both public and private paving jobs shall have cracked or defective curb replaced prior to paving.

The Town's Engineer may drill cores from completed slabs of concrete to obtain depth/thickness measurements. Sections showing a deficiency of more than 3/8 inch shall be removed and replaced to the specified depth at the Contractor's expense.

3.4.14 CLEAN UP

Ensure cleanup work is completed in a condition acceptable under these specifications within two weeks after pavement has been opened to traffic.

END OF SECTION 02400

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02500 – BASE COURSE

(Last Revised 3/09/15)

PART 1 - GENERAL

1.1 GENERAL

A. The contractor shall furnish all labor, materials, tools, equipment, and perform all work and services necessary for or incidental to the construction of pavement, as shown on drawings and as specified, in accordance with provisions of the contract documents, and completely coordinated with work of all other trades.

B. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

1.2 RELATED DOCUMENTS

A. **Section 02200 - Earthwork**

B. **Section 02600 – Paving**

1.3 GOVERNING SPECIFICATIONS

A. Requirements for asphalt pavement are set out on the drawings, these specifications, and on the standard details in this manual. Materials, construction and testing shall conform to Division 5, *Subgrade, Bases, And Shoulders*, of the NCDOT *Standard Specifications for Roads and Structures*, latest revision, a copy of which is herein incorporated by reference.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

End of Section 02500

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02600 - PAVING

(Last Revised 3/09/15)

PART 1 - GENERAL

1.1 GENERAL

A. The contractor shall furnish all labor, materials, tools, equipment, and perform all work and services necessary for or incidental to the construction of pavement, as shown on drawings and as specified, in accordance with provisions of the contract documents, and completely coordinated with work of all other trades.

B. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

1.2 RELATED DOCUMENTS

A. **Section 02500 – Base Course**

1.3 GOVERNING SPECIFICATIONS

A. Requirements for asphalt pavement are set out on the drawings and on the standard details in this manual. Materials, construction and testing shall conform to Division 6, *Asphalt Pavements* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision, a copy of which is herein incorporated by reference.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION 02600

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02700 – STORM DRAINAGE

(Last revised 3/09/15)

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

Part 1 – General
Part 2 – Products
Part 3 – Execution
Abandoning Existing Storm Lines
CB/DI Iron Castings
Concrete Class Spec
Concrete Block/Brick
Construction of Manholes/DI's
Drainage Channel Grading
Drainage Structure Installation
Flared End Sections
Geotextile Fabric
Inspection
Installation of Boxes
Laying Tolerance (pipe)
Maintenance
Mastic Pipe Joint Mat'l
Measurement & Payment
Mortar
MH Frame & Cover Spec
NCDOT Boxes (Acceptable)
RCP Spec
Pipe Bedding
Pipe Laying
Pipe Marking Require'ts
Precast Concrete Structures
Precast MH Spec
Precast Box Grade Adjustment
Reinf'd Concrete Pipe Spec
Ram-Nek
Rip Rap Placement
Rip Rap Spec
Subdrain Installation
Weep Hole Construction
Weep Hole Pipe Spec

PART 1 - GENERAL

1.1 GENERAL

A. The contractor shall furnish all labor, materials, tools, equipment and all else required for and to construct the improvements complete, tested and placed into satisfactory operation, in accordance with the contract drawings, these specifications, and the engineers' requirements under then. The contractor shall be responsible for furnishing details that are required, but not necessarily shown on the contract drawings, for the adequate and proper construction and operation of the design as required by the town of wake forest.

B. Every item mentioned, described, specified and/or referred to in these specifications, and all items shown, indicated or inferred by the contract drawings, and such items as may normally be required for the construction of the systems shall be furnished and installed complete in every respect; tested in all manners required and/or necessary; and made ready for complete and regular services, as intended. The contractor shall furnish all materials and equipment of whatever nature.

C. Insofar as possible, existing utilities must be kept in operation at all times. The contractor shall so organize and schedule his work as to cause the least inconvenience to the operation of the existing utilities. Should it become necessary to put any part of an existing system out of operation, the contractor, without cost to the owner, shall make such temporary connections, alterations, etc., as may be required to keep the existing utilities in operation.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.

B. Section 00825 – *Product Substitions*

C. Section 02210 – Trenching, Backfilling, and Compaction of Utilities

D. Town of Wake Forest Pre-Approved Material/Product List

E. NCDENR Division of Energy, Mineral and Land Resources, Land Quality Section's *North Carolina Erosion and Sedimentation Control Planning and Design Manual*.

1.3 SUMMARY

This section includes all equipment, labor, material, appurtenances, and services required for complete installation of storm drainage piping, ditches, structures, and specialties for municipal drainage systems.

1.4 DEFINITIONS

A. **General**

For the purposes of this specification, the following definitions refer to storm water drainage systems and structures that come under the authority of the Town of Wake Forest, North Carolina as specified within this section and other sections of this manual.

Public Storm Drainage System: Drainage systems and their appurtenances required for the conveyance of storm water from and across publicly maintained streets, roads, highways, and other public property and located within public rights-of-way and/or easements.

See also paragraph 1.4, Definitions of section 02210, *Trenching, Backfilling and Compaction of Utilities*.

B. **The following are industry abbreviations for various pipe materials.**

1) **RCP**: Reinforced Concrete Pipe

1.5 SUBMITTALS

A. Submit shop drawings on all non-standard or alternate products/materials to the Town's Engineer in accordance with Section 00825 – *Product Substitions*.

B. Assuming products and their appurtenances listed on the Pre-Approved Material/Product List are being used, submit product data and shop drawings for the following.

1) Non-standard size drop/curb inlets

2) Head/end walls

3) Concrete pipe specialties

1.6 QUALITY ASSURANCE

A. Comply with all codes, laws, ordinances, and regulations of governmental authorities having jurisdiction over this part of the work.

B. The contractor shall comply with NCDENR Division of Energy, Mineral and Land Resources, Land Quality Section's North Carolina Erosion and Sedimentation Control Planning and Design Manual, latest revision.

C. Piping materials shall be marked clearly and legible on the outside of each section of pipe and pipe end.

1) Reinforced Concrete Pipe shall be marked as follows:

a. Pipe Class and wall type

b. Inside diameter of pipe product

c. Manufacturer name or trademark of manufacturer

d. Date of Manufacture

e. State assigned plant number

D. For convenience, reference is made in succeeding paragraphs to specific portions of various standards. Also, modifications and additions are made. Neither the reference nor the modifications are intended to de-emphasize any other portion of the standards.

E. It is the intent of this specification that whenever a procedure or technique is not called out herein, that the industry standard, as represented by ACI, ASTM or other appropriate recommendation, shall be used.

F. Materials and operations shall comply with the latest revision of all applicable codes and standards listed below.

American Society for Testing and Materials (ASTM)

ASTM A48 (AASHTO M306)	Standard Specification for Gray Iron Castings
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C14 (AASHTO M86M)	Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C32	Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)
ASTM C33	Standard Specification for Concrete Aggregates.
ASTM C55	Standard Specification for Concrete Building Brick

ASTM C76 (AASHTO M170)	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C90	Standard Specification for Loadbearing Concrete Masonry Units
ASTM C150	Standard Specification for Portland Cement
ASTM C 478 (AASHTO M199)	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C655 (AASHTO M242)	Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM C913	Standard Specification for Precast Concrete Water and Wastewater Structures
ASTM C990	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3) (Standard Proctor).
ASTM D1556	Standard Method of Test for Density of Soil in Place by the Sand-Cone Method
ASTM D1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3) (Modified Proctor).
ASTM D2049	Standard Method of Test for Relative Density of Cohesionless Soils
ASTM D2167	Standard Method of Test for Density of Soil in place by the Rubber-Balloon Method
ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
ASTM D3740	Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D4254	Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

ASTM E329	Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E548	Standard Guide for General Criteria Used for Evaluating Laboratory Competence

American Association of State Highway & Transportation Officials (AASHTO)

AASHTO M86M	Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
AASHTO M170	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe. Three-to-one side slopes are required on flares.
AASHTO M198	Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe (Withdrawn; ASTM C990 supersedes AASHTO M198)
AASHTO M199	**Standard** Specification for Precast Reinforced Concrete Manhole Sections
AASHTO M242	Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
AASHTO M259	Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
AASHTO M273	Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than 2 ft of Cover Subjected to Highway Loadings
AASHTO M306	Standard Specification for Drainage, Sewer, Utility, and Related Castings

1.7 STANDARD ABBREVIATIONS

A. **Materials and operations to comply with the latest edition of codes and standards listed:**

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AISI	American Iron and Steel Institute
ASTM	American Society for Testing and Materials
BIA	Brick Institute of America

CRSI	Concrete Reinforcing Institute
FEMA	Federal Emergency Management Agency
FS	Federal Specifications
HEC	Hydraulic Engineering Circular
NCMA	National Concrete Masonry Association

Note: Designations such as ASTM, AASHTO, NCDOT, etc. referenced throughout this specification imply the latest revision.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Observe manufacturer's directions for delivery and storage of materials and accessories.

B. Prevent damage to pipe during transit. Repair abrasions, scars, and blemishes. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

C. Protect stored piping from entry of water or dirt into pipe. Protect bells and flanges of special fittings from entry of moisture and dirt.

D. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

E. Pipe Condition/Pipe Examination:

1) **New Pipe Inspection – All pipe**: Inspect materials thoroughly upon arrival. Examine materials for damage. Remove damaged or rejected materials from site. Pipe shall be protected during handling against impact shocks and free fall. Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate ASTM Specifications.

a. **Concrete Pipe**: Check bells and spigots closely for smoothness, roundness, and honeycombing (concrete pipe), which may be a source of infiltration. Check for cracks, chips, etc. on both ends. Reject any pipe that will not provide soil-tight seal or is otherwise structurally deficient.

2) **Pre-Installation Inspection**: Prior to being installed, each section of the pipe shall be carefully examined for damage and conformity with these specifications. All pipes damaged or deemed not to conform to these specifications shall be rejected and removed from site.

a. **Concrete Pipe**: All concrete pipes in which the spigots and bells cannot be made to fit properly, or pipe, which has chipped bells or spigots, will be rejected. The faces of all spigots ends and of all shoulders on the bells of rigid pipe must be true.

1.9 PROJECT CONDITIONS

Storm Drainage Manholes – No water mains shall pass through or come in contact with any part of a storm drainage manhole. A minimum of 3 feet of horizontal separation shall be maintained between water mains and storm drainage manholes unless otherwise approved by the Town's Engineer or City of Raleigh Public Utility Department. Interference/conflict manholes will not be permitted unless otherwise approved by same.

See also paragraph 1.8 Project Conditions of Section 02210, *Trenching, Backfilling and Compaction of Utilities.*

1.10 SERVICE INTERRUPTION

For service interruption, operation of valves, taps, fire hydrant operation, etc, contact the City of Raleigh Public Utilities Operations Division at 919.996.2737 between the hours of 7:30 AM and 4:00 PM. After 4:00 PM, call the after hour's emergency number at 919.829.1930. Provide a minimum of 48 hours notice or desired utility interruption or necessary operation of valves or hydrants.

Refer to the following link regarding service interruption: http://www.raleighnc.gov/home/content/PubUtilAdmin/Articles/WaterandSewerFAQs.html

For any other utility, contact the applicable utility agency.

1.11 COORDINATION

A. Coordinate tie-in to municipal or NCDOT junction boxes or catch basins with the Town's Engineer the NCDOT District Engineer.

B. Coordinate water and sewer service interruption with the City of Raleigh Public Utilities Department.

C. At the direction of the Town's Engineer and/or City of Raleigh Public Utilities Department, temporary pumping/bypass of sewerage flow may be required to be provided.

D. Traffic Signals: When traffic signals, loops, or their appurtenances are likely to be damaged or interfere with construction, coordinate temporary operation with the NCDOT or other applicable agency having jurisdiction of the signals. Provide a minimum of 1 weeks' notice prior to anticipated disturbance or interruption. At the discretion of the Town's Engineer, the notice may be required to be published in the newspaper.

E. Repair Of Pavement Markings: When cuts are made through any paved surface and the cuts extend through the pavement markings, the replaced pavement shall be marked to match the existing.

F. Benchmark/monument protection: Protect and maintain benchmarks, monuments or other established reference points and property corners. If disturbed or destroyed, they must be replaced at contractor's expense by a licensed Professional Surveyor to full satisfaction of owner/Town of Wake Forest.

G. Before digging, contact *"NC One Call"* at 811 for location services.

1.12 PUBLIC CONVENIENCE

The contractor shall at all times so conduct his work as to ensure the least possible inconvenience to the general public and the residents in the vicinity of the work. Fire hydrants on or adjacent to the work shall be kept accessible to firefighting equipment at all times. Temporary provisions shall be made by the Contractor to ensure the proper functioning of all gutters, sewer inlets, drainage ditches, and irrigation ditches, which shall not be obstructed except as approved by the Town's Engineer.

Refer to the Town of Wake Forest Noise Ordinance by visiting the following link: http://www.wakeforestnc.gov/residents-noiseordinance.aspx

1.13 TRAFFIC CONTROL

A. When working within any NCDOT System road or highway, conform to the *Manual On Uniform Traffic Control Devices*, latest revision (MUTCD) as well as the NCDOT Standard Specifications For Roads And Structures, latest revision.

B. Traffic maintenance shall comply with the latest revision of the NCDOT Standard Specifications For Roads And Structures, Division 9 – *Signing* and Division 11 – *Work Zone Traffic Control*, as well as other applicable sections.

C. A traffic control plan shall be submitted to the Town's Engineer or NCDOT (if applicable) for approval.

D. When traffic signals or their appurtenances are likely to be damaged or interfere with the construction, coordinate temporary operation with the NCDOT or the Town's Engineer. Provide 1 weeks' notice prior to anticipated disturbance or interruption.

E. Whenever it becomes necessary to leave a section of trench open after completion of the day's work, the contractor shall provide barricades and lights to protect the public. Operate warning lights during hours from dusk to dawn each day and as otherwise required for inclement weather and visibility.

F. Any work performed on a municipal public right-of-way or easement is required to obtain an encroachment permit from the Town of Wake Forest. A copy of the approved permit is required to be on the project site at all times.

1.14 EROSION AND SEDIMENTATION CONTROL AND NPDES MONITORING, CONTROLS, AND LIMITATIONS FOR PERMITTED DISCHARGES

Refer to the Town of Wake Forest UDO for Erosion and Sedimentation Control requirements; Chapter 12.

http://www.wakeforestnc.gov/data/sites/1/media/residents/planning/development%20services/currentudo.pdf

PART 2 - PRODUCTS

2.1 PIPE:

2.1.1. CONCRETE PIPE

A. **Reinforced Concrete PIPE**

Reinforced concrete culvert pipe shall meet the requirements of AASHTO M170 for the class of pipe called for on the plans. The design wall thickness shall be the wall thickness shown in AASHTO M170 for the applicable class and wall.—RCP shall be a minimum of Class III, Wall. Concrete pipe joints shall be tongue and groove type unless otherwise specified. RCP shall conform to the requirements of applicable sections of the latest revision of the NCDOT *Standard Specifications for Roads and Structures*.

RCP Class III or IV shall also meet ASTM C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

Gasketed joints in concrete pipe shall meet the requirements of paragraph *2.2.5, Preformed Plastic Gaskets*.

B. **PIPE MARKINGS – MARKING FOR MATERIAL SPEC COMPLIANCE**

1) All concrete pipe to be used shall be either etched "***RC X***" (where ***X*** represents the class pipe) **or** marked visibly and legibly according to the following:

a. Stamp location: spigot end of pipe on inside.

b. Stamp size stenciled letters: 1-1/2" in height minimum.

c. Code: Class 3 Reinforced Concrete: TWF-RC-3

d. Code: Plain Concrete: TWF-P

e. Stamp color: Fluorescent orange or red.

2) Unmarked pipe will be allowed only if the manufacturer furnishes a certified statement on the entire shipment and etchings are placed on each pipe joint.

2.2 PRECAST CONCRETE STRUCTURES

2.2.1. PRECAST UNDERGROUND CONCRETE UTILITY STRUCTURES

A. Structures of precast reinforced concrete shall be designed and manufactured in accordance with ASTM C913, *Standard Specification for Precast Concrete Water and Wastewater Structures* and ASTM C858, *Standard Specification for Underground Precast Concrete Utility Structures*, latest revision with preformed butyl rubber joint sealant meeting ASTM C990, *Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed flexible Joint Sealants*, latest revision. Type Concrete used in the construction of the Utility Structures shall have a minimum 28-day compressive strength of 4000-psi air entrained (with 4 to 6 percent air) conforming to ASTM C33 *Standard Specification for Concrete Aggregates* and ASTM C94 *Standard Specification for Ready-Mixed Concrete.* Unless shown otherwise on the drawings, structures are to have steps. Steel reinforcing shall conform to the requirements of ASTM C857, *Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures,* latest revision. Structures shall be designed for an HL93 (equivalent to HS20-44) loading in traffic areas. See the *Town of Wake Forest Pre-Approved Material/Product List* for a list of acceptable manufacturers and models.

B. Concrete to be minimum 4000 PSI. Provide all reinforcing steel which meets ASTM A615 for grade 60 and welded wire fabric conforming to ASTM A185. Welded wire fabric may be substituted for rebar as long as the same area of steel is provided.

C. There shall be additional reinforcing provided at all openings.

D. Place lift holes or pins in accordance with OSHA standard 1926.704.

E. Provide Precast structures over 3'-6" in depth with steps as directed by the Town's Engineer.

F. All junction boxes that are not grated are to be manufactured to receive manhole iron castings (blind manholes are not permitted).

2.2.2. CATCH BASIN DROP INLETS & COMBINATION CURB OPENING INLETS

A. Catch basin drop inlet or combination curb inlet boxes may be either precast reinforced concrete or concrete block. Precast inlet boxes shall conform to the requirements of *paragraph 2.2.1, Precast Underground Concrete Utility Structures*, as well as all applicable sections of the latest revision of the *NCDOT Standard Specifications for Roads and Structures*. Refer to Standard Details 9.50, 9.51, 9.54, 9.55, and 9.56.

A. Inlet grates shall conform to the requirements of paragraph *2.3.9, Miscellaneous Gray Iron Castings*, and the applicable sections of the latest revision of the NCDOT *Standard Specifications for Roads and Structures*.

B. Catch basin grates and curb opening inlet hoods are to be embossed with the words "Dump No Waste! Drains to Waterway." Castings shall also contain an embossed trout symbol. See Standard Detail 9.71 and 9.72.

C. See the *Town of Wake Forest Pre-Approved Material/Product List* for a list of acceptable manufacturers and models.

2.2.3. PRECAST REINFORCED CONCRETE MANHOLES

A. Precast reinforced concrete manholes shall be designed and manufactured in accordance with ASTM C478, *Standard Specification for Precast Reinforced Concrete Manhole Sections*, latest revision and AASHTO M199. Either an "O" ring joint conforming to the requirements of ASTM C443 *Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets* or joints conforming to ASTM C990 *Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants* may be used.

Type Concrete used in the construction of the manholes shall have a minimum 28-day compressive strength of 4000-psi air entrained (with 4 to 6 percent air) conforming to ASTM C33 *Standard Specification for Concrete Aggregates* and ASTM C94 *Standard Specification for Ready-Mixed Concrete*. Manholes shall have monolithic base and eccentric cone flattop as applicable. Structures are to have steps. Manholes will have extended bases with appropriate reinforcing as directed by the Town's Engineer. See the *Town of Wake Forest Pre-Approved Material/Product List* for a list of acceptable manufacturers and models.

See Standard Detail 9.60.

2.2.4. CONCRETE FLARED END SECTIONS

A. Concrete flared end sections shall meet all applicable requirements of AASHTO M170 except those pertaining to design. All concrete flared end sections shall be reinforced. The concrete used in flared end sections shall be air entrained and shall attain strength of 3500 psi when tested in accordance with AASHTO T22. 3:1 slopes are required on flared ends.

2.2.5. PREFORMED PLASTIC GASKETS (JOINT SEALER)

A. Preformed plastic gaskets shall meet federal specification SS-S-00210 (210-a) *Sealing Compound, Preformed Plastic, For Expansion Joints And Pipe Joints*, Type 1, Rope Form or Type 2, Flat Type and ASTM C990. Sag or flow resistance and chemical resistance shall meet ASTM C990 *Standard Specification For Joints For Concrete Pipe, Manholes, And Precast Box Sections Using Preformed Flexible Joint Sealants*, latest revision. Preformed butyl gaskets shall be used with structures meeting ASTM C478, ASTM C990 and AASHTO M199. Minimum rope diameter to be 3/4-inch or as required for the size structure.

2.2.6. WEEP HOLE PIPE

A. Weep hole pipe shall be minimum schedule 40 PVC meeting ASTM D1785 *Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120* or D2665 *Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.*

2.3 MISCELLANEOUS

2.3.1. BEDDING

A. See section paragraph 2.1.2 *Pipe Bedding* of Specification Section 02210, *Trenching, Backfilling, and Compaction of Utilities.*

2.3.2. BRICK

A. Clay Brick (not permitted in the building of drainage structures): Brick shall be hard clay, grade SW (earth contact/freezing), ASTM C 32, *Standard Specification for Sewer and Manhole Brick (made from clay or shale)* and AASHTO M91. Use brick of uniform standard commercial size, with straight and parallel edges and square corners that are burned hard and entirely true, free from injurious cracks and flows, tough, strong, and having a clear ring when struck together. The sides, ends, and faces of all brick shall be plane surfaces at right angles and parallel to each other. Brick of the same manufacturer shall not vary more than +/- 1/16-inch in thickness, plus or minus 1/8-inch in width and +/_ ¼-inch in length.

B. Concrete Brick: Concrete brick shall meet the requirements of ASTM C55 for Grade S-II except that the absorption of brick used in minor drainage structures shall not exceed 10 pcf.

2.3.3. CONCRETE BUILDING BLOCK

A. Solid Concrete Building Block: Use concrete building block that meets the requirements of ASTM C90[1]. Block is to be free of chips and cracks. The Town's Engineer may require that the block be pink in color to indicate compliance with NCDOT specifications.

B. Solid Concrete Block: Solid concrete block to be used in lieu of clay brick for minor drainage structures shall meet the requirements of ASTM C139, *Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes*. Except that the nominal dimensions shall be 4"x8"x16".

2.3.4. MISCELLANEOUS CONCRETE

A. Concrete classes (NCDOT) to design compressive strength at 28 days (f'c):

Class AA	General	4,500-psi
Class A	General	3,000-psi
Class B	Massive or Lightly Reinforced	2,500-psi

B. Ready mixed concrete shall comply with ASTM C94, *Standard Specification For Ready-Mixed Concrete*. All exposed concrete shall be air entrained. Concrete strength shall be as specified on standard details and drawings. Unless otherwise specified, all concrete shall be Class A, minimum.

2.3.5. MORTAR FOR CONCRETE BLOCK & BRICK

A. Mortar shall be Type M, ASTM C270, *Standard Specification for Mortar for Unit Masonry* and ASTM C144, *Standard Specification for Aggregate for Masonry Mortar*. Mortar shall be prepared from cement in perfect condition and shall be prepared in boxes for that purpose. No mortar that has stood beyond 45 minutes shall be used.

When specified by the Town's Engineer, grout for cellular fill of block or voids shall be comprised of 3000-psi ready mix concrete with pea gravel aggregate. Do not provide air entrainment unless specified by the Town's Engineer.

2.3.6. PORTLAND CEMENT

Type I, CSA normal, ASTM C150 *Standard Specification for Portland Cement*.

2.3.7. GEOTEXTILE FABRIC:

A. Geotextile fabric shall be protected from mud, dirt, dust, sunlight, and debris during transport and storage. Material shall be inert to commonly encountered chemicals; resistant to mildew, rot, insects, and rodents; and biologically and thermally stable. Geotextile fabric for subsurface installation shall not be exposed to direct sunlight for more than 24 hours before or during installation.

B. Filter fabric for rip rap: filter fabric for rip rap and rip rap beddings shall conform to Section 1056 – *Engineering Fabrics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 2 Engineering Fabric.

[1] Type I/Type II unit designation eliminated in ASTM C90 in 2000.

C. Fabric for subsurface drains: non-woven needle-punched fabric for subsurface drains shall conform to Section 1056 – *Engineering Fabrics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 1 Engineering Fabric.

2.3.8. MANHOLE FRAMES AND COVERS

A. Standard frames and covers: manhole frames and covers shall meet ASTM A48 *Standard Specification For Gray Iron Castings*, Class 35B, traffic frame and cover. Castings to be designed for a minimum HS-20 load. See the *town of wake forest pre-approved material/product list* for a list of acceptable manufacturers and models. Standard manhole frames and covers shall be manufactured to the dimensions and configurations shown on Standard Detail 9.70 and shall have a minimum of four 1-inch diameter holes in the flange of the frame. Manholes castings may be either bituminous coated or plain. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. Weights shall not vary more than 5%+/- of the weight shown on Standard Detail 9.70.

B. Cast-in-place frames and covers: manhole frames and covers shall meet ASTM A48 *Standard Specification For Gray Iron Castings*, Class 35B, traffic frame and cover. See the *Town of Wake Forest Pre-Approved Material/Product List* for a list of acceptable manufacturers and models. Frames shall be plain un-coated. Manhole covers may be either bituminous coated or plain. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking.

C. Covers are to be embossed along the perimeter with the words "Storm Water" and "Dump No Waste. Drains to Waterway." See Standard Detail 9.70.

D. See the *Town Of Wake Forest Pre-Approved Material/Product List* for a list of acceptable manufacturers and models.

2.3.9. MISCELLANEOUS GRAY IRON CASTINGS

A. Catch basin frames and grates: supply gray iron castings meeting the requirements of ASTM A48 *Standard Specification For Gray Iron Castings*, Class 35B of AASHTO M306 as manufactured by Capitol Foundry, US Foundry or East Jordan Iron Works. Castings to be designed for a minimum HS-20 load. Boldly fillet castings at angles, and provide rises that are sharp and perfect. No sharp, un-filleted angles or corners are permitted. Provide castings that are true to pattern in form and dimension, free from pouring faults, sponginess, cracks, blowholes, and other defects affecting their strength and value for the service intended. Welding is not allowed for the purpose of making a casting structurally sound. Welding for cosmetic or other purposes is not allowed without approval of the Town's Engineer. The iron material used in products provided shall have a minimum recycled material content of 75%. The recycled material shall consist of post-consumer material.

2.3.10. REINFORCING STEEL

A. Reinforcing steel shall conform to ASTM A615 *Specification For Deformed Billet-Steel Bars For Concrete Reinforcement*, grade 60.

2.3.11. RIP RAP AND RIP RAP BEDDING

A. Rip rap and rip rap bedding shall conform to Section 1042 – *Rip Rap Material* of the NCDOT *Standard Specifications For Roadways And Structures*, latest revision for Class A, B, 1 and 2 rip rap.

2.3.12. SUBSURFACE DRAINAGE

A. Subsurface drains shall conform to section 1044 – *Subsurface Drainage Materials* Of The NCDOT *Standard Specifications For Roadways And Structures*, latest revision.

2.3.13. MISCELLANEOUS STORMWATER APPURTENANCES

A. All miscellaneous stormwater appurtenances including but not limited to endwalls, headwalls, and flared end sections shall conform to all applicable sections of the latest revision of the NCDOT *Standard Specifications for Roads and Structures.*

PART 3 - EXECUTION

3.1 PREPARATION:

A. See paragraph 3.1 *Preparation* of Specification Section 02210 *Trenching, Backfilling and Compaction of Utilities.*

3.2 PIPE BEDDING AND BACKFILL CLASS DEFINITIONS

A. **Pipe Bedding Definitions**: See Standard Detail 9.53 for Concrete Pipe. See also paragraph 2.1.2 *Pipe Bedding of Specification* and paragraph 3.5.10 Bedding Condition Section 02210 *Trenching, Backfilling and Compaction of Utilities.*

B. **Backfill Material Class Definitions**: See Standard Detail 9.53 for Concrete Pipe. See also paragraph 2.1.1 *Trench Backfill Material Classification* of Specification Section 02210 *Trenching, Backfilling and Compaction of Utilities.*

3.3 EXCAVATING, TRENCHING AND BEDDING

A. **General:**

Excavate, trench and bed for storm drainage structures in accordance with 02210 - Trenching, Backfilling and Compaction of Utilities and the following specifications.

Storm sewers shall be laid to line and grade as established by the designing Engineer where shown on the plans or as directed. All pipelines and structures will be constructed by the use of competent workmen under the supervision of experienced foremen. Great care shall be taken to obtain well-aligned and tight pipelines in order to assure good flow.

B. **Bedding Rigid Pipe**

1) Trench Width: Trench width shall be per Standard Detail 9.53 unless approved otherwise by the Town's Engineer.

2) Pipe Bedding: Refer to Standard Detail 9.53, Table 2 for acceptable bedding material and depth.

Generally, a stone bedding is not required ***unless*** the subgrade conditions are either wet, a stone cushion is needed between a hard subgrade and the pipe, or a stone bedding is called for by the Town's Engineer.

When bedding stone is required, the bottom of the excavated pipe trench shall be located as directed by the Engineer and to a depth specified by the Engineer but the depth shall be no less than 4-inches below the bottom of the pipe for pipes 24-inches or smaller in diameter. Based on the Installation Type, the trench subgrade will be thoroughly compacted as specified in Table 2 of Standard Detail 9.53. If specified density of subgrade cannot be achieved, improve the trench subgrade by the placement of foundation stone sufficient upon which to place the pipe bedding as specified on Standard Detail 9.53 and to a depth determined by the Town's Engineer. The stone material shall be placed to assure no foreign matter is enveloped in the stone mat. Stone for such purpose shall be of uniform size - not less than that specified in Standard Detail 9.53 - the width of the mat shall be the width of the trench.

3) ***In wet areas only*** or ***unless specified or directed otherwise by the Town's Engineer***, all but the bottom 2 inches of the pipe joint (as measured across the diameter of the pipe) shall be sealed using a butyl resin gasket.

4) **Bedding in Rock**: See paragraph 3.5.6.F *Cushioning Pipe in Rock* in Specification Section 02210 *Trenching, Backfilling and Compaction of Utilities* and Standard Detail 9.53.

5) Throughout the entire length of the pipe, provide a bedding surface for the pipe with a firm foundation of uniform density. See Standard Detail 9.53 for storm drain installation and bedding requirements based on Type of Installation (Type 1, 2, 3 or 4). Compact bedding as applicable.

6) Provide bell holes and depressions for pipe joints of only the length, depth, and width required for making the particular pipe joint properly.

7) Minimum cover over pipe shall be 6 inches in non traffic areas. Where pipe has less than 12-inches of cover below a roadbed, the pipe shall be reinforced with a concrete bedding.

3.4 LAYING PIPE

A. **General:**

1) Prior to placing pipe, carefully examine each:

Promptly set aside defective pipe and damaged pipe. See paragraph 1.8 Product Delivery, Handling and Storage for other elements.

a. Clearly identify defects.

b. Do not install defective pipe or damaged pipe.

c. Verify product meets specs. See paragraph 2.1.1.B Pipe Markings for required pipe markings/certifications.

d. Pipe with varying wall class must not be mixed between manholes or boxes.

e. Unless otherwise noted on plans or directed by Engineer, do not exceed bury limitations shown in Fill Height Table as shown on Standard Detail 9.53.

2) Pipe Alignment: Place pipe to the grades and alignment indicated within a tolerance of 1:1000 vertical and 1:500 horizontal, unless otherwise directed by the Town's Engineer. Horizontal curves will be allowed for large pipe (greater than 48 inches in diameter) where pipe has been manufactured with a beveled end.

3) **Directional Changes in Pipe**: Use manholes for changes in direction of gravity lines. The Town's Engineer may permit horizontal curves in pipe alignment for pipe greater than 48 inches in diameter where pipe has been manufactured with a beveled end.

4) **Joining Pipe of Different Size or Material:** A drainage structure box is required at all pipe intersections (vertical and horizontal) and changes in pipe size or pipe material. Unless otherwise approved by the Town's Engineer, lateral taps and branches are not permitted without a junction box.

5) At the direction of the Town's Engineer, the invert grade between structures shall be cambered by an amount sufficient to prevent the development of sag or back slope in the flow line. The Town's Engineer will determine the amount of camber to be used.

6) **Stringing out Pipe**: When pipe is strung out during unloading, it shall be set on high ground and in a position to prevent silt deposits, storm water, or other matter from entering the pipe prior to its placement in the trench.

7) Provide adequate facilities for lowering pipe safely into the trenches.

8) Do not place pipe in water, or place pipe when trench or weather is unsuitable for such work.

B. **OSHA Trench Protection**: Excavation shall be performed in accordance with OSHA Standard 29 CFR Part 1926, "Safety and Health Regulations for Construction," Subpart P "Excavations," Standard Number 1926.650, latest revision *and in accordance with* paragraph 3.5.1.C *OSHA Trench Protection* of Specification Section 02210 T*renching, Backfilling and Compaction of Utilities*.

3.5 PIPE JOINTS & PIPE LAYING

3.5.1. CONCRETE PIPE

A. **Laying concrete Pipe:**

1) Only proper and suitable tools and appliances for the safe and convenient handling, raising, lowering and laying of pipes and fittings shall be used. Pipe and fittings shall be carefully handled and lowered into the trench. Workmen shall not be located either below or in pipe being moved, raised or lowered. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench. All damaged pipe shall be replaced at the Contractor's expense.

2) Trenches shall be kept as dry as possible during bedding, laying and jointing and for as long a period as required until the trench is backfilled.

3) **Pipe Laying Direction**: Place piping beginning at low point and progress uphill. Place pipe by proceeding upgrade with the **spigot ends** of *bell and spigot pipe*, and the **tongue ends** of *tongue and groove pipe*, pointing in the direction of flow. Place on grade, with unbroken continuity in invert, horizontally and vertically, and on alignment as indicated on plans. Place bell or groove ends of piping facing upstream. Install gaskets, seals, sleeve, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements. Where open joints are left in the invert per paragraph 3.5.1.E.4.a.iii, Wet Areas, wrap joint with a non-woven Geotextile fabric around as specified in.

4) The ends of pipe shall abut against each other in such manner that there shall be no shoulder or unevenness of any kind along the inside of the bottom half of the pipeline.

5) Special care shall be taken to ensure that the pipes are well bedded on a solid foundation, and no pipe shall be brought into position until the preceding length has been thoroughly embedded and secured in place.

6) As each joint is laid, visually inspect to be certain that no jointing compound gasket, or trash is protruding from the joint or lying inside the pipe.

7) As soon as possible after the joint is made, sufficient backfill material shall be placed along each side of the pipe to offset conditions that might tend to move the pipe off line or grade. The greatest care shall be used to secure water tightness and to prevent damage to or disturbing of the joints during the backfilling process, or at any other time.

8) The Contractor, at his own expense, shall make good any defects due to settlement. Bell holes shall be dug sufficiently large to ensure the making of proper joints. Water shall not be allowed to rise in the excavation until the joint material has been placed and/or received its set. Except at the points where the bottom of pipe is left open, the greatest care shall be used to secure water tightness throughout the rest of the joint and to prevent damage to or disturbing of the joints during the backfilling process, or at any other time.

9) Whenever a pipe requires cutting, to fit into the line or to bring it to the required location, the work shall be done in satisfactory manner, so as to leave a smooth end, and without extra compensation. The Engineer may require 6 and 8-foot joints if equipment and conditions warrant.

10) Lifting holes shall be plugged according to the manufacturer's recommendations. A sheet of geo-fabric shall be placed over the plugged lifting hole and pipe extending 18" from either side of the hole.

B. **Pipe Displacement by construction machinery/installation:**

1) Use all means necessary to avoid displacement of, and injury to, pipe and structures while compacting by rolling or operating equipment parallel to the pipe.

2) Movement of construction machinery over a culvert or storm drain, prior to, during and after backfilling and compaction, is solely at the Contractor's risk.

C. Temporary Suspension of Work: When the trench is left for the night or if pipe laying is suspended, all exposed ends of the pipe shall be plugged to keep out dirt, water, animals and other foreign matter or substances. This plug shall be kept in the ends of the pipeline at all times when laying is not in actual progress.

D. Cutting or Fitting Pipe: Whenever a pipe requires cutting to bring a pipe to the required location, the work shall be done in a satisfactory manner with an approved cutting tool or tools that will leave a smooth end at right angles to the axis of the pipe and not otherwise damage the pipe. The method of cutting pipe shall be in accordance with manufacturer's recommendations. Such cuts shall be made by the contractor without extra compensation.

E. **Joining Concrete Pipe**

1) Before laying, the bell and spigot will be wiped free from any dirt or other foreign matter.

2) All surfaces of the portion of the pipe to be joined, and the factory-made jointing material, shall be clean and dry.

3) Wipe the inside of the joint clean and smooth. Perform wiping by dragging a suitable swab or long handled brush through the pipe as installation progresses.

4) Unless otherwise directed by the Town's Engineer, use the following methods of joining for *bell and spigot* and *tongue and groove* pipe:

a. Flexible watertight joints in concrete pipe.

i) Use butyl resin gaskets conforming to paragraph 2.2.5 Preformed Plastic Gaskets. See also Town of Wake Forest Pre-Approved Material/Product List.

ii) Install gaskets and joint materials in accordance with the manufacturers' recommendations and as approved by the Engineer or his representative. The jointing material or factory-fabricated joints shall then be placed, fitted, and adjusted in such skillful manner as to obtain the degrees of water tightness required.

iii) Wet Areas: *In wet areas only or unless specified or directed otherwise by the Town's Engineer*, the bottom 2-inches of the pipe joint (as measured across the diameter of the pipe) shall be left unsealed to permit infiltration of groundwater. The pipe shall be bedded in #57 stone in such applications. Prior to or during placement of the pipe on the stone bedding, place an 18-inch wide strip of non-woven Geotextile separation fabric along the perimeter of the pipe joint to prevent migration of fines into the pipe. Attach fabric to pipe wall with tape or mastic to hold in place during backfill. Lap fabric ends a minimum of 12 inches and tape/seal.

iv) Protect from sun, blowing dust, and other deleterious agents at all times.

v) Align the pipe with previously installed pipe, and pull the joint together. If, while making the joint, the gasket or jointing material becomes loose and can be seen through exterior joint recess when joint is pulled to within 1 inch of closure, remove pipe and remake the joint.

vi) Inspect gaskets, and replace loose and improperly affixed gaskets and jointing materials.

b. Doubling gasket material: Where a sealed joint is not achieved as required, the Contractor shall either pull the pipe out and double Ram-Nek or mortar and wipe the pipe joints inside (where possible) and outside. Mortared joints shall be wiped smooth and protected against drying by covering with wet burlap.

c. At the Town's Engineer's discretion, he/she may request that all joints shall be left exposed for inspection purposes during the working day. At that time, a suitable ladder affording easy and safe access for such inspection shall be furnished.

3.5.2. JOINING PIPE OF DIFFERENT MATERIALS:

A. Where new concrete pipe ties-in to an existing pipe of a different type of material, provide fittings or couplings made for the pipe material jointing, or provide a concrete collar as approved by the Town's Engineer.

3.5.3. SAMPLE JOINT TO BE MADE AND APPROVED:

A. Before any joints are actually made in the trench, the Contractor shall demonstrate to the Town's Engineer, by making a sample joint, that the methods which he will employ conform to the specifications and will secure a watertight joint, and that the workmen whom he intends to use in this work are familiar with the requirements.

3.6 DRAINAGE STRUCTURES

3.6.1. GENERAL:

A. Clay brick structures are not permitted.

B. Junction boxes, catch basins, combination boxes, headwalls, etc. may be constructed of concrete brick or concrete block. Structures may be of either reinforced masonry or non-reinforced masonry depending upon either the standard shown on these specifications and/or the details shown on the plans/contract drawings by the engineer of record.

C. Formed inverts:

1) To reduce turbulence, all junction boxes, manholes etc. shall have formed inverts, regardless of pipe size or box type, formed to the spring-line of the pipe as shown on the plans or as directed by the Town's Engineer. The flow line of the box invert shall be of uniform grade from the invert of the influent line to the invert of the effluent line. Inverts shall be constructed of block, brick and mortar with a brushed finish. Invert forming is to be performed after the pipe penetrations have been made, the annular space around the pipe grouted and the pipe sawn flush with the interior face of the structure.

D. All junction boxes, manholes, catch basins etc. shall have 2-inch diameter weep holes, approximately 7 inches off bottom, on each wall or as directed by the Engineer. Holes shall be constructed of 2-inch PVC pipe laid in mortar as the block is brought up. See also paragraph 2.2.6 for Weep Hole Pipe material and paragraph 3.6.6 for Weep Hole Construction.

E. No sand traps shall be constructed in the bottoms unless so directed by the Town's Engineer.

F. **Manhole Junction Boxes**: Every non-grated junction box or manhole shall have a manhole access. No blind manholes or junction boxes are permitted.

G. Frame and grate height may be adjusted with concrete or brick in accordance with Town of Wake Forest specifications. Use manhole frame and cover as indicated on the plans. Reinforce manhole opening in top as shown on standard details or as designed by NC Professional Engineer for required loading condition.

H. **Design**

1) Boxes to be designed by NC Professional Engineers and approved by Town's Engineer for AASHTO HL93 loading condition.[2]

2) **Steps**: For structures over 3'-6" in depth, provide steps. Steps are to be located on a non-pipe wall. Steps shall meet the applicable OSHA requirements. See also Standard Detail 9.74.

I. **Bedding**: See paragraph 3.5.6.G *Cushioning for Structures* of Specification Section 02210 *Trenching, Backfilling and Compaction of Utilities.*

J. **Catch Basins And Inlets:**

1) **General**: All catch basins and inlets shall be standard NCDOT curb-opening inlet/grate type in accordance with NCDOT standard detail 840.03 with appropriate grate (see Standard Detail 9.50), unless otherwise specifically designated on the plans and approved by the Town's Engineer. The depth of a catch basin will normally be 4-feet. This depth may be increased or decreased by the Engineer as necessary to meet local conditions.

2) All pipe lines entering a masonry catch basin shall be placed upon the concrete slab prior to beginning any brickwork. The brickwork shall be brought up snugly around such lines and a tight connection made to prevent any washouts and cavities at the basin.

3) Catch basins shall be constructed on line and grade as given by the designer and in the locations as specified. Castings shall be set true to line and grade.

3.6.2. UNREINFORCED MASONRY STRUCTURES:

A. In non-reinforced masonry construction, the unit used shall conform to the requirements of paragraph 2.3.3 concrete building block.

[2] HL93 design truck wheel load is same as HS20-44 wheel load without lane loading (which does not apply to below ground structures as confirmed by ASTM C1577 and permitted by AASHTO).

B. The walls shall be constructed of concrete building brick in the manner as shown on the plans, corbelling in as necessary to meet the standard casting specified. Masonry construction shall conform to section 834, *block masonry construction – general and* section 840, *minor drainage structures* of the NCDOT *Standard Specifications for Roads and Structures,* latest edition. All concrete brick shall be soaked in water to refusal before being used. Upon use, the excess adhering surface water shall be wiped off.

C. Masonry boxes may be used with the Town of Wake Forest Standard Details 9.50, 9.51, 9.54, 9.55, and 9.56. See also Table 2700.1 for a list of other approved NCDOT standards with concrete brick boxes.

D. Maximum depth: See Standard Detail 9.57, *Drainage Structure Notes*. Structures to be designed by NC Professional Engineer and approved by Town's Engineer. See paragraph 3.5.1.H.1 Design.

E. Maximum wall span: Minimum wall thickness: minimum wall thickness of all boxes and manholes shall be 8 inches solid concrete brick masonry or 8 inches concrete block with concrete filled cells for all boxes or manholes 12 feet or less in depth. The maximum horizontal wall span of an unreinforced 8-inch thick masonry wall shall not exceed 5 feet for boxes 8 feet or less in depth without special engineering. See Standard Detail 9.57 *Drainage Structure Notes* for other requirements.

F. The bottom for the masonry structures shall be no less than 6 inches thick unless shown otherwise on the plans and approved by the Town's Engineer.

F. Mortar in masonry structures is to be ASTM C270, Type S or M.

G. **Pipe Penetrations**: Inside of boxes shall allow for 6 inches of clearance on both sides of pipe. The dimension shown on the structures in the standard details are minimum box dimensions. For boxes with greater dimensions add a reinforced concrete top slab or lengthen the box by adding additional grates and frames).

3.6.3. PRECAST REINFORCED CONCRETE STORM DRAINAGE BOX STRUCTURES (Flush Wall, Waffle And Knockout Panel Type):

A. Precast reinforced concrete catch basins and inlets: Precast catch basins and inlets shall conform to the requirements of paragraph 2.2.1 *Precast Underground Concrete Utility Structures*.

B. Design requirements: See paragraph 2.2.1, precast underground concrete utility structures

C. **Maximum Depth** (manhole junction boxes and catch basins): Limit maximum depth to top of bottom slab for waffle wall structure to 10'-0"; limit solid wall structure to 15'-0" unless approved otherwise by the Town's Engineer.

D. **Grade adjustment**: Precast storm drainage boxes with knockout panels shall be set to the prescribed grade designated on the construction drawings. Precast boxes shall be placed on a stone bed of a minimum of 6 inches of #57 stone. Boxes shall be adjusted to final grade by the addition of either precast reinforced concrete grade rings or solid clay brick or concrete masonry with type M mortar. Boxes may not be saw cut to lower the grade unless first approved by the Town's Engineer and then by no more than 2 inches. Due to the potential for grade variation in setting the structures, and to

avoid cutting the boxes, it is recommended that boxes be ordered slightly short of the depth required to permit final grade adjustment by adding risers. However, the total depth of riser ring or masonry adjustment shall not exceed 8 inches.

E. See also Table 2700.1 for a list of approved NCDOT standards for other masonry and precast boxes.

F. **Pipe Penetration(s) Into Precast Boxes:**

1) Cut or form openings for pipe to provide required size and location. Remove knockout panels by saw cutting. Cut to pipe OD plus 2 inches.

2) Orient waffle wall structures so that pipes enter through the knockout/waffle panels only.

3) Preformed pipe penetrations may enter through the corners of solid wall precast boxes if a minimum of 6" of wall is provided above the hole.

4) Patching: The pipe shall be placed in the hole and the annular opening grouted the full 360 degrees of the pipe diameter with concrete. The grouted pipe penetration shall be inspected prior to backfilling. Once the concrete collar has set (4 days minimum), pipe(s) protruding into the box shall be cut flush with the inside face of the box and the annular edge grouted to form a smooth entrance.

3.6.4. ACCEPTABLE NCDOT STANDARD BOXES

A. The following NCDOT standards are approved for use in the Town of Wake Forest:

Table 2700.1	
Detail	**Sheet Title**
840.01	Brick Catch Basin – 12" thru 54"
840.02	Concrete Catch Basin – 12" thru 54"
840.05	Brick Open Throat Catch Basin – 12" thru 48" Pipe
840.14	Concrete Drop Inlet – 12" thru 30" Pipe
840.15	Brick Drop Inlet – 12" thru 30" Pipe
840.17	Concrete Grated Drop Inlet Type 'A' – 12" thru 72" Pipe
840.18	Concrete Grated Drop Inlet Type 'B' – 12" thru 36" Pipe
840.19	Concrete Grated Drop Inlet Type 'D' – 12" thru 36" Pipe
840.26	Brick Grated Drop Inlet Type 'A' – 12" thru 72" Pipe
840.27	Brick Grated Drop Inlet Type 'B' – 12" thru 36" Pipe
840.28	Brick Grated Drop Inlet Type 'D' – 12" thru 36" Pipe
840.31	Concrete Junction Box – 12" thru 66" Pipe
840.32	Brick Junction Box – 12" thru 66" Pipe
840.45	Precast Drainage Structure (1 of 2)
840.46	Precast Drainage Structure (2 of 2)

3.6.5. MANHOLE CONSTRUCTION FOR PRECAST STANDARD MANHOLES AND DROP INLET BASES

A. **Precast Reinforced Concrete Manholes:** Manholes of precast reinforced concrete shall be designed and manufactured in accordance with ASTM C478. The wall shall be a minimum of 5 inches thick and have a 6-inch minimum base. The standard joint shall be sealed with plastic cement putty meeting Federal Specification SS-C-153. Either an "O" ring or "ram neck" joint seal may be used. The "O" ring joint shall conform to the requirements of ASTM C443. The gasketed joint shall conform to ASTM C990 (AASHTO M199).

Concrete used in the construction of the manholes shall have a minimum 28 day strength of 4000 psi air entrained (with 4 to 6 percent air) conforming to ASTM C-33 and ASTM C-94. Manhole units shall consist of standard modular precast riser sections, modular riser sections and a monolithic base (except doghouse bases are to be used when placing manholes over existing mains). Manhole steps shall be integrally cast in to the walls of the manhole sections. Where conditions do not favorably accommodate the use of an eccentric cone, eccentric precast reinforced concrete flat tops are to be used. Manholes over 12 feet in depth, as measured from top of casting to effluent invert, shall have extended bases with appropriate reinforcing. Manholes steps shall be located perpendicular to the flow.

B. **Standard Manhole Junction Boxes:** Manholes shall be constructed in accordance with the Town of Wake Forest Standard Details 9.60 and 9.61 with the following exceptions:

1) Flexible boots and precast concrete inverts will not be required.

2) Joints will be as specified in paragraph 2.2.3 of this specification.

3) The pipe opening in precast units shall be at least 4 inches but not more than 8 inches larger than the outside diameter of the pipe. Pipe openings shall be formed, drilled, or neatly cut as approved by the Engineer.

4) The Contractor shall pack the annular opening between the pipe culvert and the precast structure with grout. Such materials shall be thoroughly bonded to both the pipe and structure.

5) Do not plug weep holes. Place a non-woven Geotextile fabric over weep holes.

6) Pour concrete inverts in all structures. Concrete shall be in compliance with products section for miscellaneous concrete of these specifications. Shape manhole channel with a smooth semicircular bottom matching inside diameter of the connecting pipe/pipes. Change directions of flow with a smooth curve of as large a radius as the manhole size will permit. Change size and grade of channels gradually and evenly. Shape the shelf to provide a slope between 1 and 2 inches per foot towards the invert. See Standard Details 9.60 and 9.61.

7) Manholes shall be installed plumb.

8) Manholes shall be no less than 4 feet in diameter. Larger diameter manholes needed to accommodate larger pipe shall be sized based on an angle of entry sufficient to accommodate adjacent pipe, with sufficient annular clearance to permit pipe entry into manhole, while also providing a vertical undisturbed column of reinforced concrete between adjacent pipes of at least 8 inches in thickness for manholes up to 12 feet in depth.

9) NCDOT Standard Detail 840.53 may only be used if approved by the Town's Engineer prior to its proposed use.

10) Manholes shall be fabricated in such a way as to minimize the potential of the pipe landing in a riser joint.

C. **Replacement/Rehabilitation of Existing Manholes**: where the new grade of the storm drain is such that, in the judgment of the Town's Engineer, a new manhole is necessary, the old manhole must be completely removed and a new precast manhole set in its place. Where the old manhole is of satisfactory quality, the contractor will make connection thereto as directed by the Town's Engineer at no additional cost even if it is necessary to modify the manhole to meet the new grade. Such extras are considered incidental to the manhole connection cost.

D. **Adjustments**: The Contractor shall exercise care in the ordering of structures so that the use of brick for leveling and adjustments can be minimized. Where adjustment of a manhole is required, unless otherwise directed by the Town's Engineer, grade rings shall be used. The depth of grade rings shall not exceed 12 inches before removal of the cone or flat top is necessary for adjustment.

On all storm manholes, a mastic joint material shall be placed between the iron frame and the cone or grade ring.

When applicable, during the installation of manholes, if frame and cover is near or within wheel path in roadway, turn cone to place the frame out of wheel path.

3.6.6. WEEP HOLE CONSTRUCTION / POROUS BACKFILL

Placement of drainpipes for weep holes and porous backfill material shall conform to the Town of Wake Forest applicable standard details and the requirements of the NCDOT *Standard Specifications for Roads and Structures,* Section 420-11, *Drains in Walls and Culverts.* Construct in accordance with Sections 414-7 and 414-8 of the NCDOT Standard Specifications. See par graph 2.2.6 for PVC pipe spec.

3.6.7. CATCH BASIN-MANHOLE COMBINATION:

In some locations, as shown on the plans, it will be necessary to construct a combination catch basin-manhole. The specifications as given above for manholes and catch basins shall be adhered to as applicable. This structure will have a standard round manhole shape at the bottom with a standard manhole bottom, but will be furred in at the top to meet a standard catch basin casting.

3.7 CONSTRUCTION OF MISCELLANEOUS APPURTENANCES

End walls and other miscellaneous storm drainage items shall be constructed in accordance with the latest edition of the NCDOT *Standard Specifications For Roads and Structures* and the applicable NCDOT standard details.

3.8 SUBDRAINS

A. Where considered necessary by the Town's Engineer or otherwise recommended by a Geotechnical Engineer, due to a seasonal high ground water condition which would

pose a threat to the structural integrity of the street pavement section, a 6-inch diameter helical steel sub-drains shall be installed. The subdrain shall be at grades shown or as directed and stone shall completely encircle the sub-drain pipe for a minimum distance of one diameter from the pipe in all directions. Installation of subsurface drainage systems shall conform to the requirements of section 815 – *Subsurface Drainage* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision using non-woven needle-punched fabric. The stone shall be wrapped in fabric.

The stone shall be of uniform size and shall be enclosed in the filter media cloth. The pipe, stone and filter media shall be as specified in the materials section of these specifications.

Subdrain pipe grade shall generally follow the top of curb or edge of pavement grade except that the minimum slope shall be 0.5% for 6-inch helical steel pipe subdrain. Subdrains shall tie into catch basins or storm manholes. No bends will be allowed.

3.9 ABANDONING STORM DRAINAGE LINES & MANHOLES

A. **Storm Lines**: Unless directed otherwise by the Town's Engineer, when an existing storm drainage line is designated to be abandoned in place, the low end of the line is to be plugged and lean concrete grout pumped into the line until line is completely filled.

3.10 EXCAVATION OF DRAINAGE CHANNELS

A. Open storm drainage channels and ditches shall be graded and shaped in accordance with the elevations, slopes, widths, and lengths indicated on the plans except that the side slopes shall be 3:1 or flatter. The outfall elevation of the new channels and ditches shall be graded to match the flow elevations of all existing or natural channels, unless indicated or specified otherwise.

B. The drainage channels shaped with fill materials shall be compacted within the limits and in accordance with the related backfill work specified elsewhere.

C. The drainage channels shall be prepared, seeded, and mulched in accordance with the related work specified elsewhere. Where indicated on the drawings, specified, or otherwise directed by the Town's Engineer, erosions control measures, such as temporary liners, rip rap, concrete liners, etc., shall be provided.

3.11 PLACEMENT OF RIP RAP AND RIP RAP BEDDING AT PIPE OUTLET PROTECTION

A. Placement of rip rap and fabric shall conform to section 876 – *rip rap* of the NCDOT *Standard Specifications For Roadways And Structures*, latest revision.

3.12 PAVEMENT REPLACEMENT

Where it is necessary to install pipe or structures under existing pavement, the Contractor will be required to replace all pavement, curb, sidewalk, or any structures damaged at his expense unless a line item is given for replacement of pavement. Payment, if allowed for by the unit price, shall be by the square yard. Pavement repair shall be in accordance with Standard Detail 9.06.

3.13 INSPECTION

A. At any time during construction up to and including completion of entire pipe installation, the Town's Engineer may inspect the work in part or as a whole in order to satisfy himself/herself that every portion of the project has been faithfully carried out in accordance with the plans, specifications, and standard details, as applicable.

B. If, in the opinion of the Town's Engineer, a defect exists in the pipeline or its appurtenances, in some place not accessible except by uncovering, the Town's Engineer may order the line to be uncovered. If it is found that after the pipe has been uncovered at the order of the Town's Engineer, no defect exists or that the defects were not the fault of the contractor, then the expense so incurred by the contractor shall be borne by the town.

C. Flush all sand, dirt, and debris from the lines prior to acceptance. Video taping of lines is to be performed in the presence of a town representative

D. Inspect the system for conformance with line and grades shown on the plans and provide record drawing measurements on record drawings.

E. **Visual inspection**: all lines and manholes shall be visually inspected by the town of wake forest from every manhole by use of mirrors. At the direction of the Town's Engineer, areas of questionable construction may be inspected by the town using television cameras (which are to be provided by developer and/or contractor). The lines shall exhibit a fully circular pattern when viewed from one manhole to the next. Lines, which do not exhibit a true and correct line and grade, have obstruction or structural defects, shall be corrected to meet these specifications and the barrel left clean for its entire length.

F. **Laying tolerance: place pipe to the grades and alignment shown on the plans**

1) **Horizontal Laying Tolerance**: 1:500 horizontal (straight runs), unless otherwise directed by the Town's Engineer.

2) **Vertical Laying Tolerance**: Unless otherwise directed by the Town's Engineer, the maximum permitted negative grade variation in post-construction pipe grade shall be -10% of the design grade. The computation of the post-construction pipe grade shall be based on a post-construction field survey. The grade shall be computed by taking the actual difference between the invert in and invert out of the pipe run divided by the actual pipe length. Pipe runs laid at less than the approved design grade must be removed and re-laid.

Example:

Design Grade: 0.005 ft//ft or 0.5%

Field Check of Grade:

Surveyed Invert in =	*96.50*	
less Surveyed Invert out =	*96.04*	
Difference =	*0.46*	
Actual Pipe Run Length =	*100*	*(not measured C-C of Boxes!)*

Slope = $\frac{0.46}{100}$ *.0046 or 0.46%*

Variation Check:
Design Grade 0.50%
Actual Grade 0.46%
Difference: 0.04%

Allowable deviation is 10% of Design Grade = 0.10 x 0.50% = 0.05%

Allowable deviation of 0.05% > 0.04% allowable deviation…VARIATION OK!

3.14 MAINTENANCE

The developer shall maintain all pipe installations in such a condition that they will function continuously from the time the pipe is installed until the development/project is accepted for maintenance by the Town. Furthermore, soil erosion and sedimentation control measures shall be installed wherever necessary, including at curb inlets for example, and maintained for the duration of the development until the project is fully stabilized. Once permanent groundcover has been established, temporary erosion control measures shall be removed and the disturbed areas landscaped and seeded.

3.15 MEASUREMENT & PAYMENT

3.15.1. MEASUREMENT

A. **Pipe**: measurement of pipe shall be from the exact beginning of the pipe to end of pipe. Measurement is not to include that distance through manholes or junction boxes. Lateral lines for catch basins and other connections will be measured and paid for in the same manner. All mains and laterals shall be measured alike except that under no circumstances shall measurement be made through any one manhole for more than one line.

B. **Manholes**: measurement of manholes shall be either by depth of the manhole or per unit as identified in the proposal.

   1) **Unit method**: When the unit method is used, manholes shall be considered a unit inclusive of casting, bolting frames, stone bedding, connection, mortar, steps, gaskets, setting, finishing, bolting, invert forming, breaking/cutting of protruding pipe edges and finishing edges. The unit method shall also be used for manholes where wide departure is made from a standard. No extra payment shall be made for warping to meet local conditions.

C. **Catch Basins**: Catch basins shall be paid for by unit price as bid in the proposal, said unit price to include all costs of the basin including precast units, brick work, frames, stone bedding, connection, mortar, steps, gaskets, setting, finishing, bolting frames, invert forming, breaking/cutting of protruding pipe edges and finishing edges. No extra payment shall be made for warping to meet local conditions.

D. **End/Headwalls, Special Structures**: These shall be paid by lump sum for the structure as designated in the contract drawings and called for in the itemized proposal.

E. **Pavement Repair**: By the square yard. The pavement section shall be as detailed on the plans, which may be either full depth asphalt or a combination of asphalt and ABC. The cost of pavement repair shall include saw cutting existing asphalt, removal, cut maintenance, compaction of subgrade, tack coat, paving and 12 month warranty. See Standard Detail 9.06.

F. **Bedding Stone**: Bedding stone shall be #5, #57, #67 or #467 clean stone. Payment for bedding stone shall be made by the ton. Measurement for bedding stone shall be computed by a maximum width of the trench of the pipe OD plus 12-inches on each side of the pipe times the depth of bedding stone, which corresponds to the bedding class used. Stone tickets will be required to verify payment.

G. **Foundation Stone**: Surge pile stone, #5, #57 or other stone as directed by the Town's Engineer, by the ton. Stone depth for building a foundation under pipe shall be based on the actual stone needed to improve the foundation but no more than 1/3 the pipe diameter being laid unless approved otherwise by the Town's Engineer. Stone tickets will be required to verify payment estimates.

H. **Trench Borrow**: Trench borrow will be paid by the cubic yard for material placed in trenches.

I. **Rock**: Rock shall be paid by the cubic yard for rock removed by blasting. No pay for rock removed by ripping.

J. **Subdrain**: Payment will be made by the linear foot of line laid. The cost shall include pipe, fittings, stone, fabric, trenching, backfill, compaction, equipment , labor and basin tie-in.

3.15.2. PAYMENT:

A. Payment for storm drainage items shall be by the unit according to the bid price in the proposal.

END OF SECTION 02700

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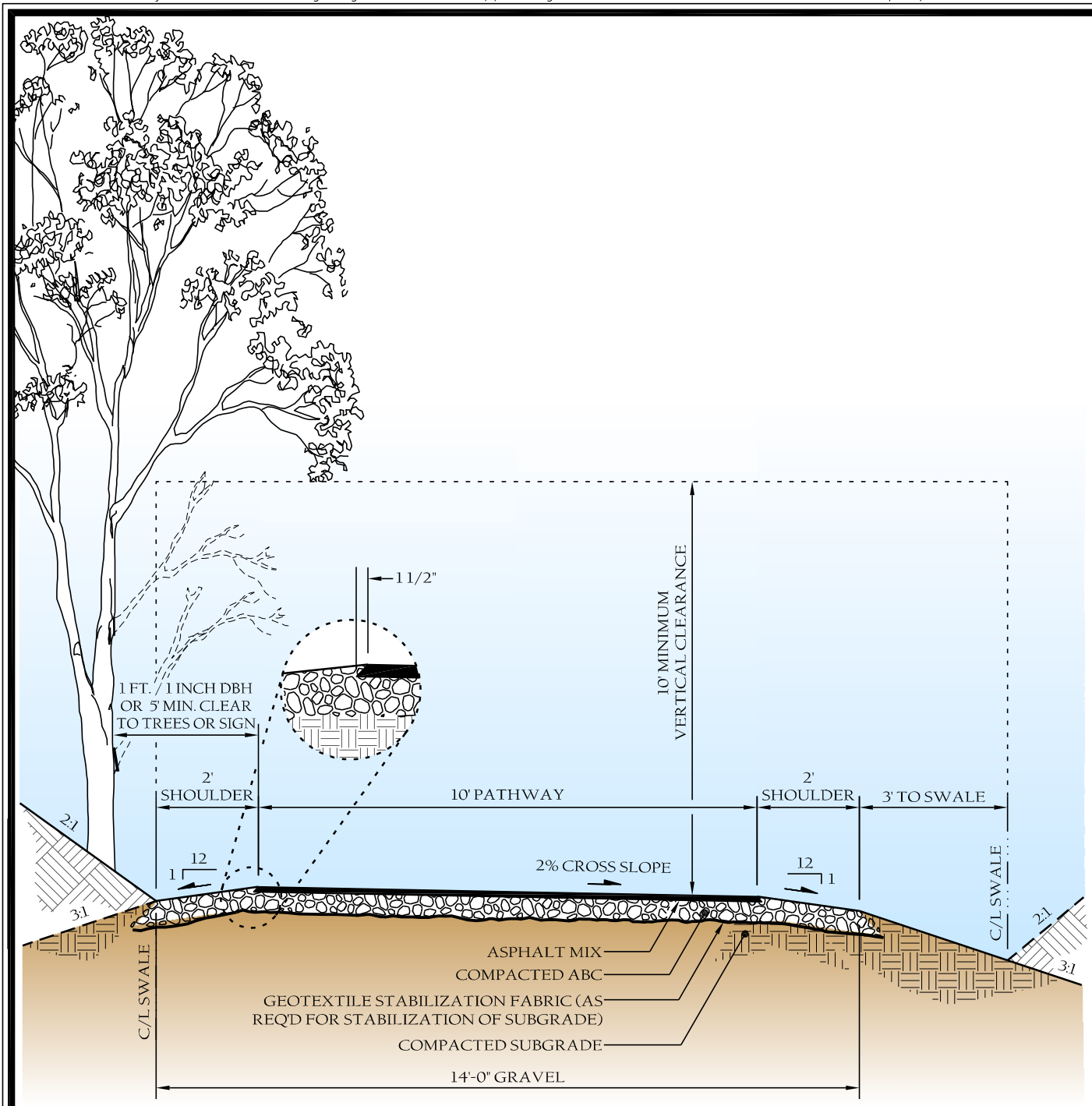
bj.WakeForestSpecs.Specs.TOWF02700StormDrainage.doc



ASPHALT SECTION

PAVED

PAVEMENT SECTION:

Pavement section must be designed by geotechnical engineer based on applicable soil and traffic load conditions.

TOWN of WAKE FOREST

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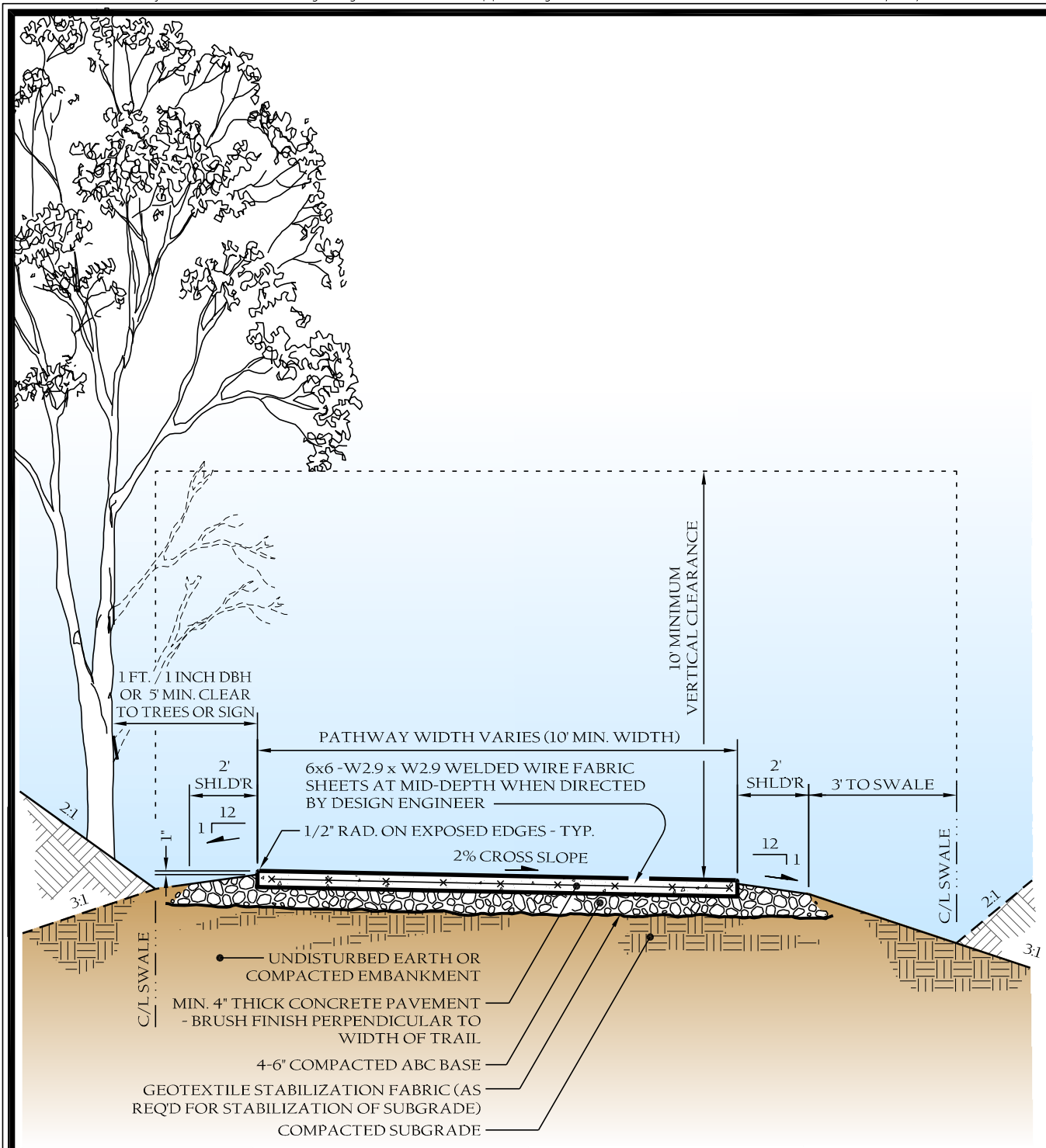
GREENWAY
ASPHALT PAVEMENT SECTION

Scale:	Detail #:
Not To Scale	8.01
Revision Date: Feb., 2015	451



CONCRETE SURFACED TRAIL OPTION

PAVED

NOTES:

1. *Place saw-cut transverse control joints at maximum of 12' o/c or as otherwise shown on plans.*
2. *Place transverse expansion joints as shown on plans.*
3. *Trail section shown may be altered to conform to Geotechnical Investigation findings.*
4. *Concrete to be min. 3000 PSI @ 28 days air entrained.*

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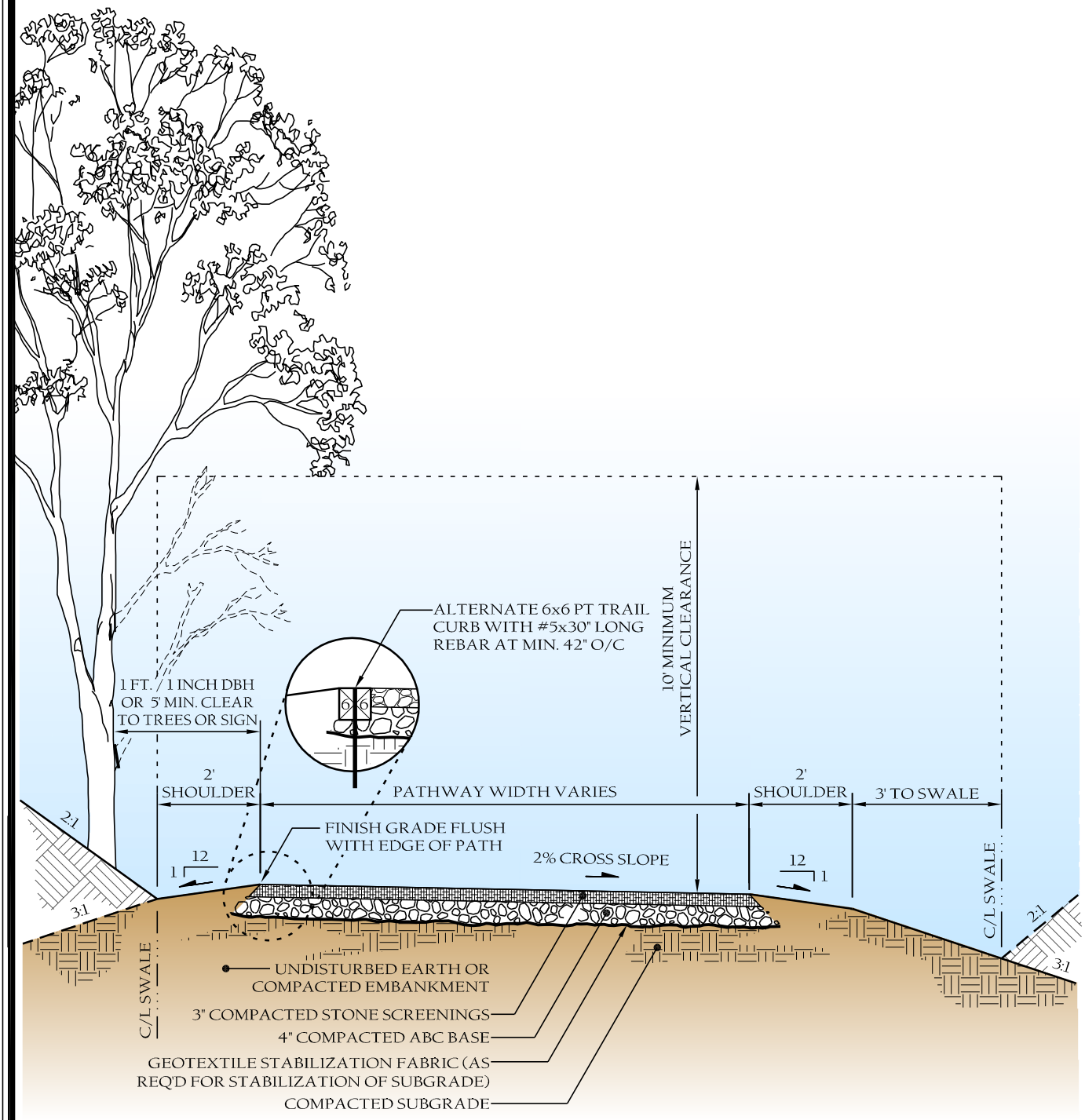
GREENWAY
CONCRETE SURFACED TRAIL OPTION

Scale:	Detail #:
Not To Scale	8.02
Revision Date: Feb., 2015	452



SOFT SURFACE STONE TRAIL

UNPAVED

TOWN of WAKE FOREST

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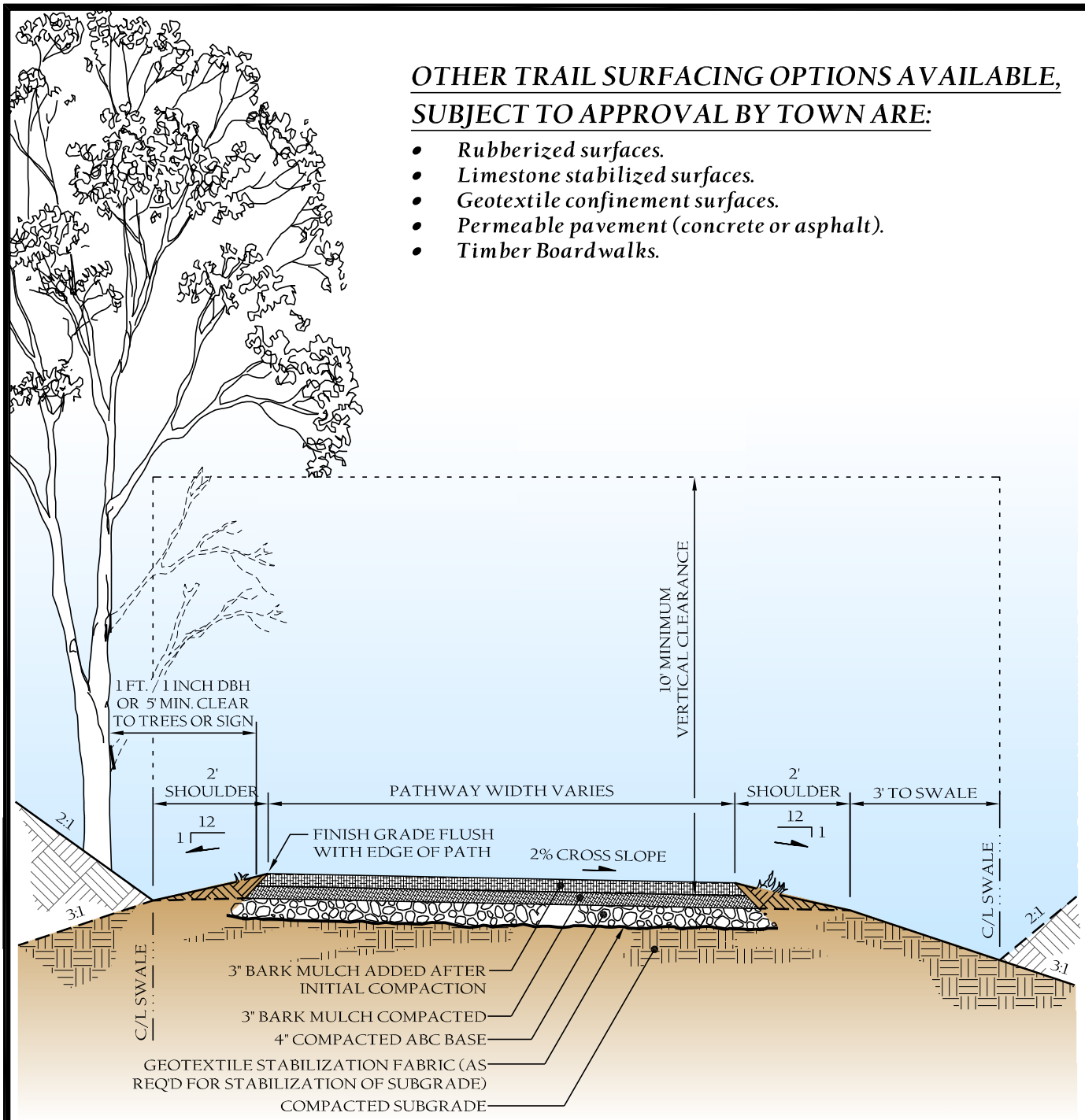
GREENWAY
SOFT SURFACE STONE TRAIL

Scale:	Detail #:
Not To Scale	8.03
Revision Date: Feb., 2015	453

OTHER TRAIL SURFACING OPTIONS AVAILABLE, SUBJECT TO APPROVAL BY TOWN ARE:

- *Rubberized surfaces.*
- *Limestone stabilized surfaces.*
- *Geotextile confinement surfaces.*
- *Permeable pavement (concrete or asphalt).*
- *Timber Boardwalks.*



SOFT SURFACE BARK MULCH TRAIL

UNPAVED

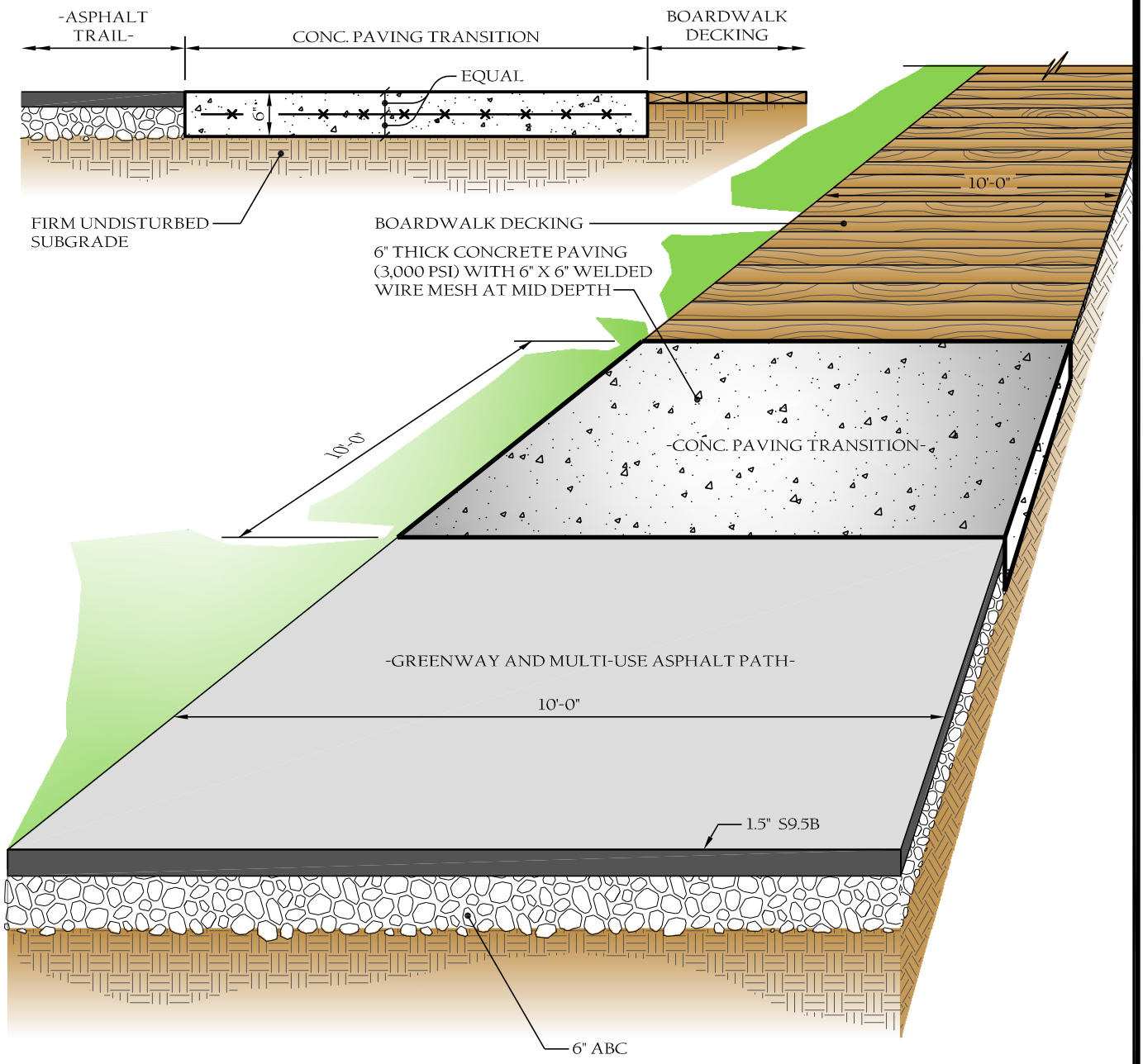
TOWN of WAKE FOREST

TOWN of WAKE FOREST, NC

Manual of Specifications, Standards and Design

GREENWAY
SOFT SURFACE BARK MULCH TRAIL

Scale:	Detail #:
Not To Scale	8.04
Revision Date: Feb., 2015	454



NOTES:

1. Concrete transition pad to be a minimum of 3,000 PSI @ 28 days air entrained.

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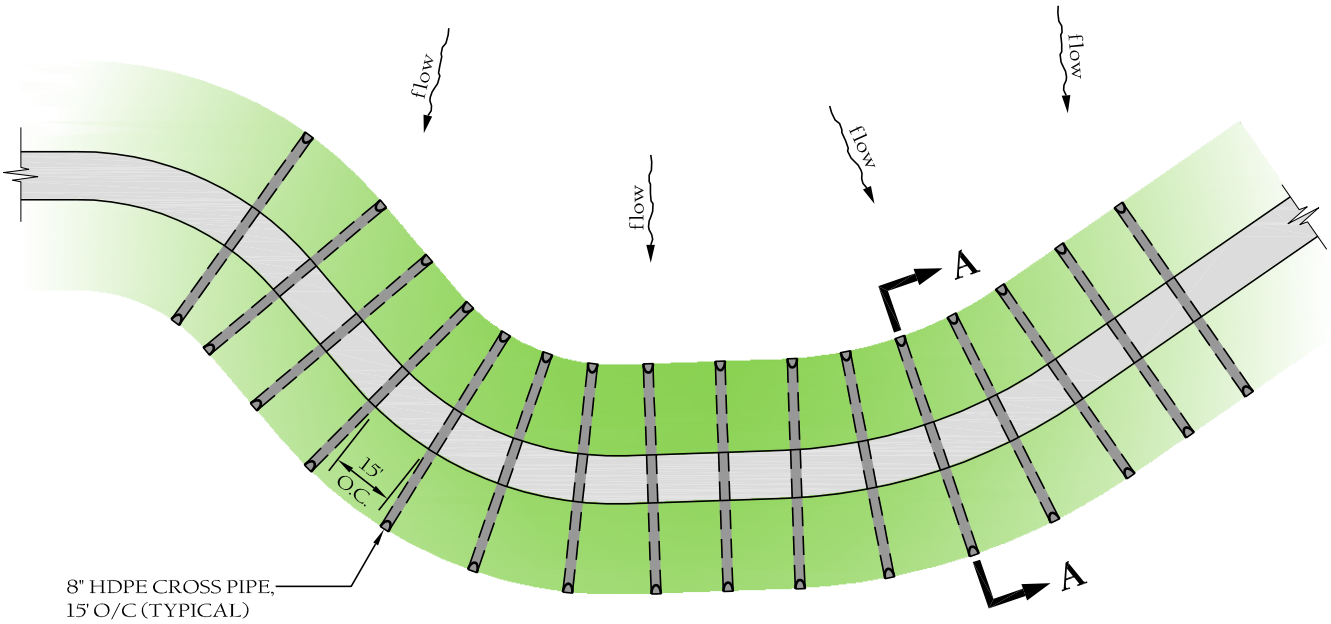
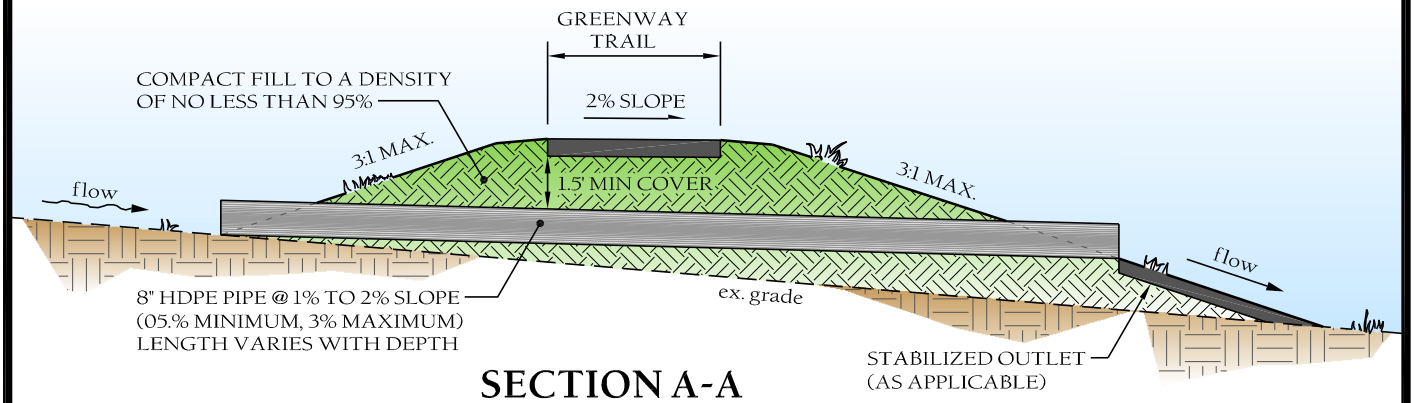
STANDARD BOARDWALK APPROACH

Scale:	Detail #:
Not To Scale	8.05
Revision Date: Feb., 2015	455



PLAN VIEW



SECTION A-A

NOTES:

1. Concrete transition pad to be a minimum of 3,000 PSI air entrained @ 28 days.

TOWN of WAKE FOREST

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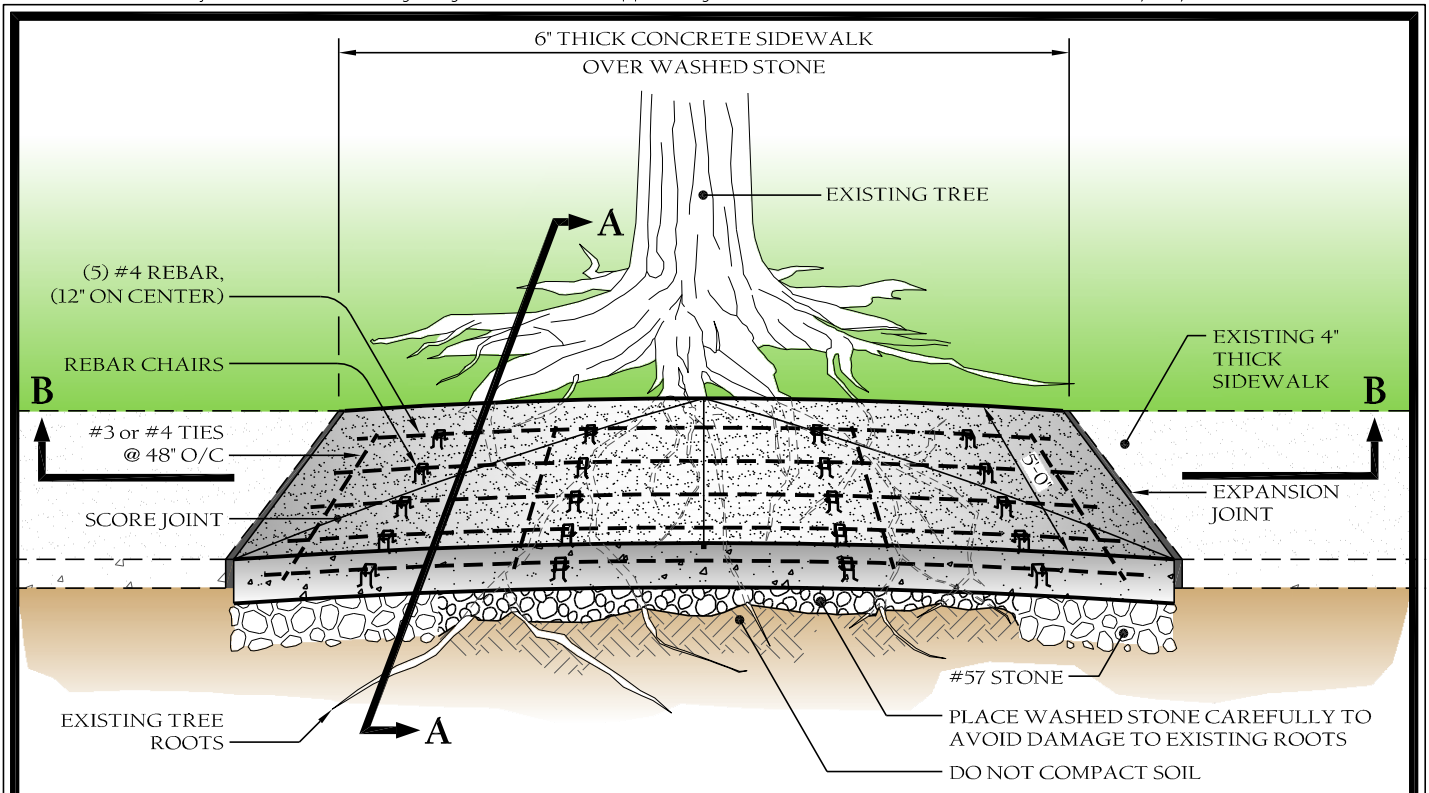
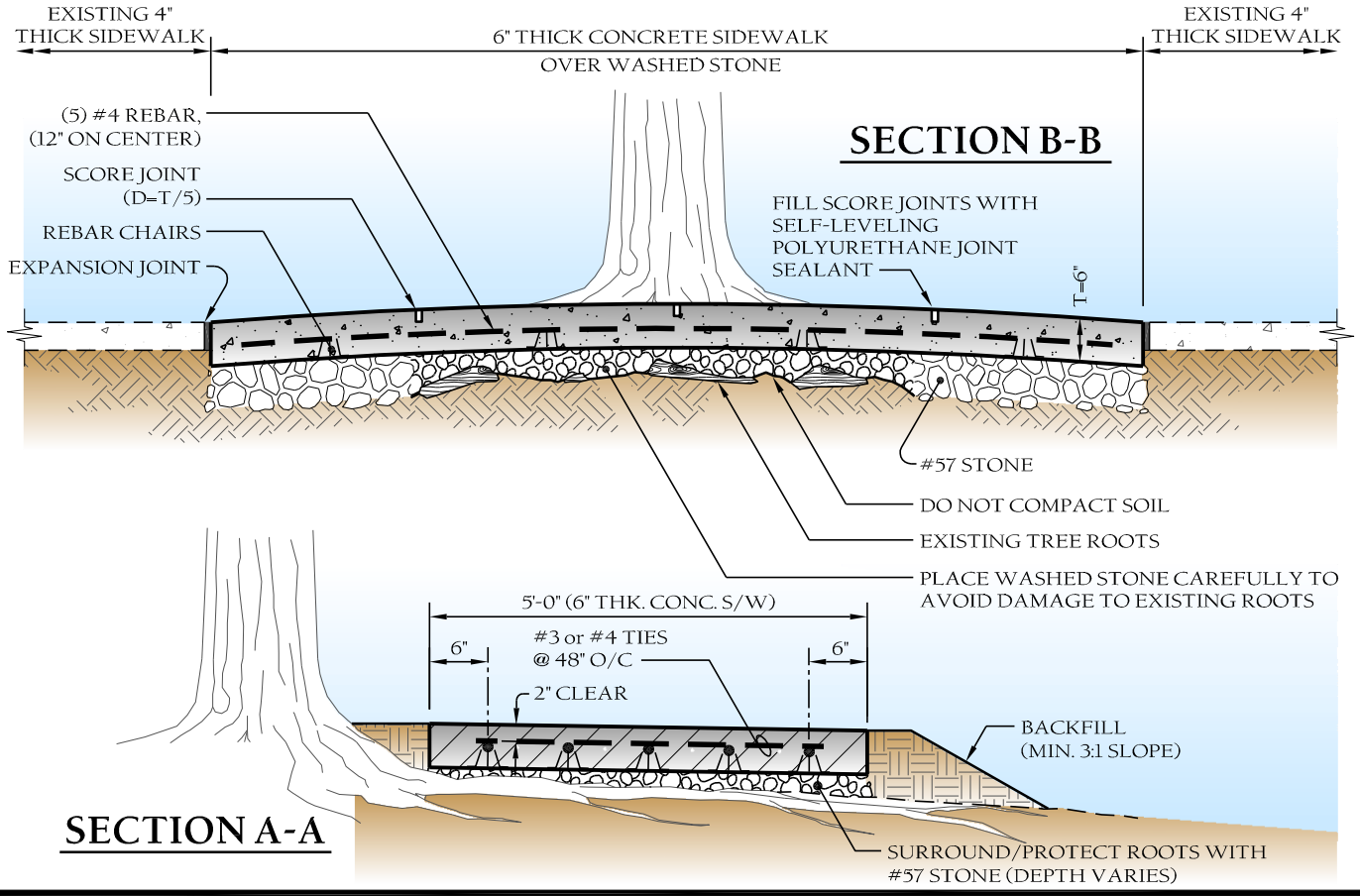
GREENWAY TRAIL DRAINAGE CROSSING

Scale:	Detail #:
Not To Scale	8.06
Revision Date: Feb., 2015	456





TOWN of WAKE FOREST

TOWN of WAKE FOREST, NC

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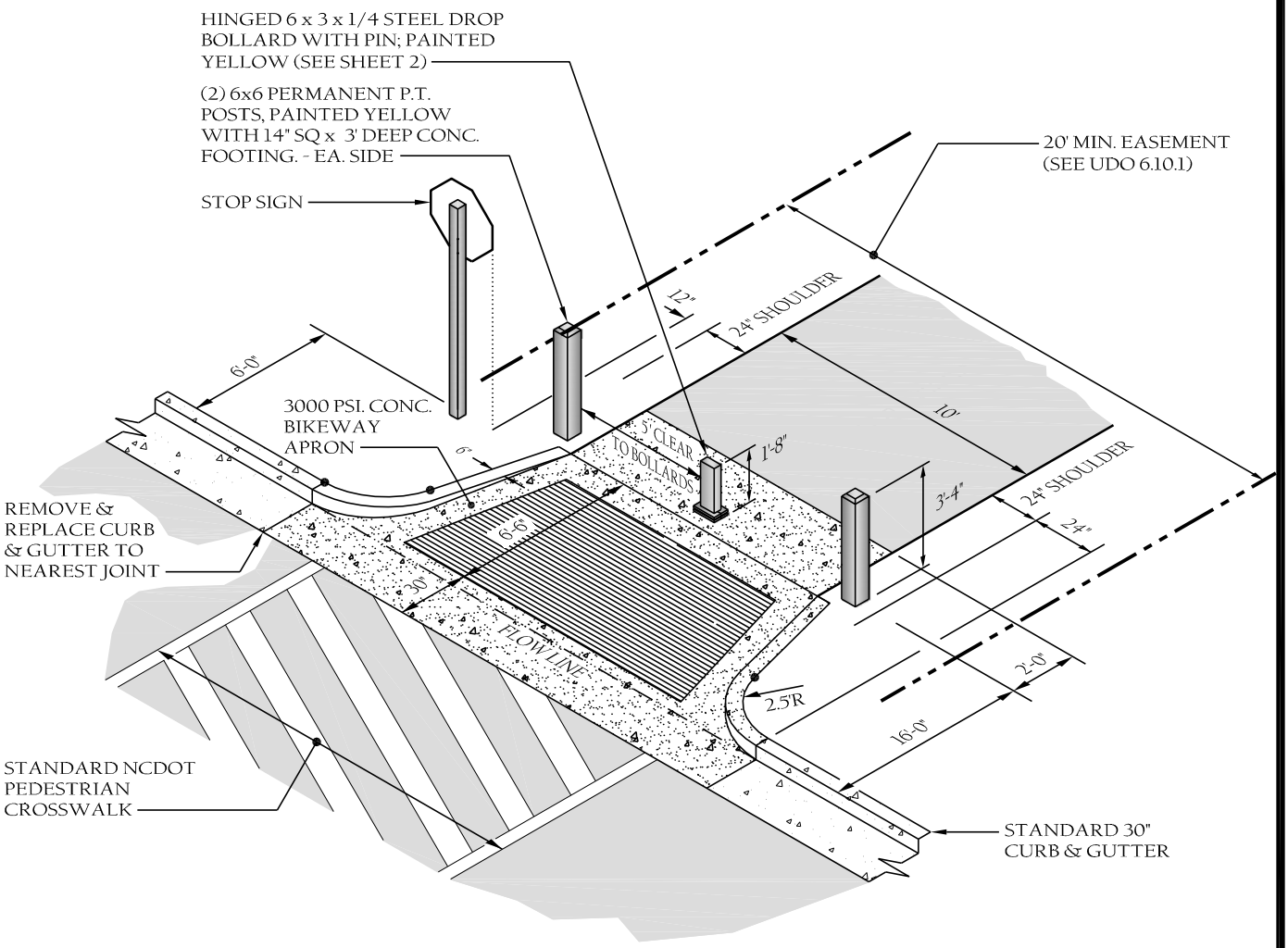
REINFORCED CONCRETE SIDEWALK (BRIDGING TREE ROOTS)

Scale:	Detail #:
Not To Scale	8.07
Revision Date: Feb., 2015	457



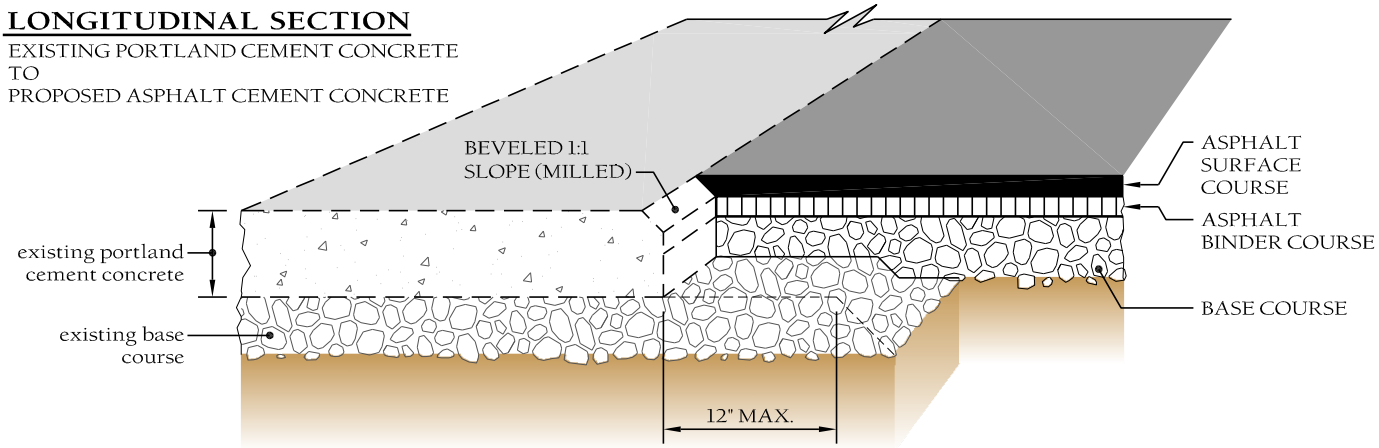
NOTES:

1. *Steel drop bollard may be constructed as shown on sheet 2 or a Traffic Guard Low Profile Heavy Duty Hinged Bollard may be used (Model LPHDHB) installed per manufacturer's directions.*

TOWN of WAKE FOREST	**TOWN of WAKE FOREST, NC** Manual of Specifications, Standards and Design		
	MULTI-USE PATH DETAIL STREET TIE-IN	Scale: Not To Scale	Detail #: 8.08
		Revision Date: Feb., 2015	458

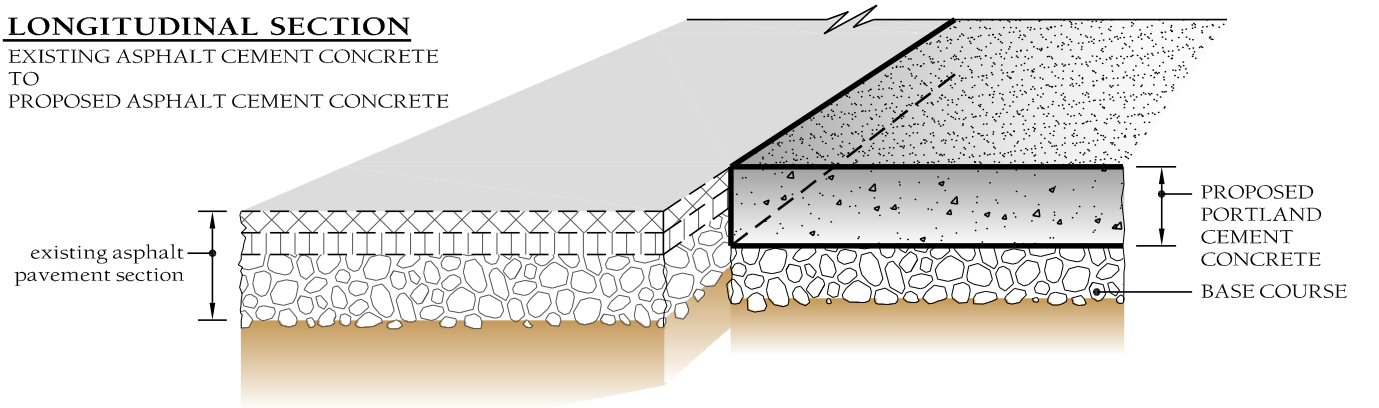
LONGITUDINAL SECTION

EXISTING PORTLAND CEMENT CONCRETE
TO
PROPOSED ASPHALT CEMENT CONCRETE



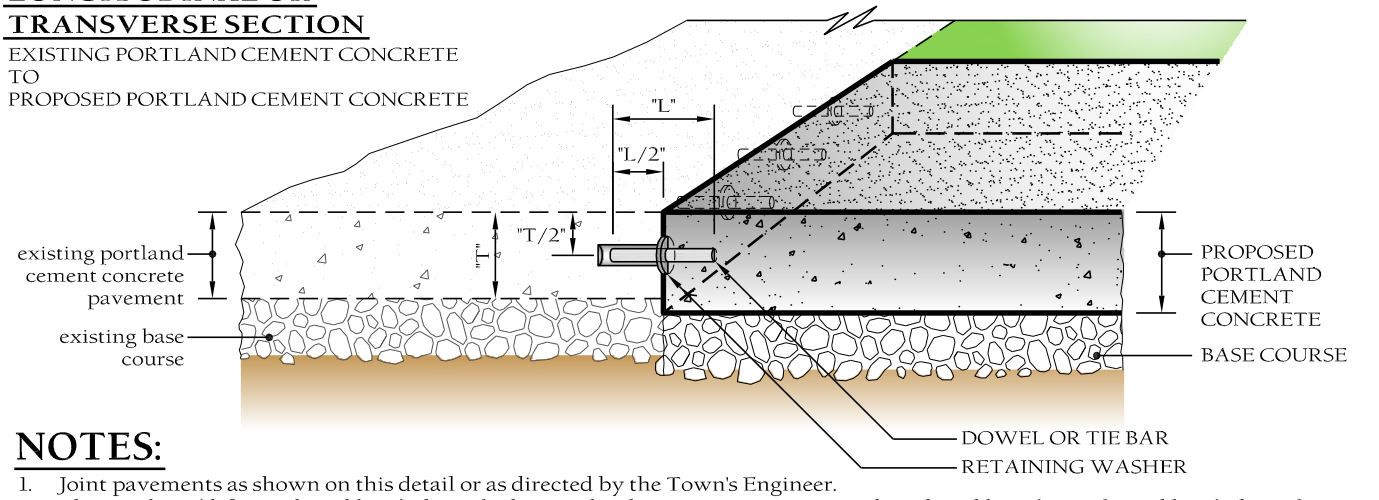
LONGITUDINAL SECTION

EXISTING ASPHALT CEMENT CONCRETE
TO
PROPOSED ASPHALT CEMENT CONCRETE



LONGITUDINAL OR TRANSVERSE SECTION

EXISTING PORTLAND CEMENT CONCRETE
TO
PROPOSED PORTLAND CEMENT CONCRETE



NOTES:

1. Joint pavements as shown on this detail or as directed by the Town's Engineer.
2. Place tie bars (deformed steel bars) along the longitudinal joints at 30" on center. Place dowel bars (smooth steel bars) along the traverse joints at 12" on center. The placement and/or spacing of tie or dowel bars may be modified by the plans of the Town's Engineer. Measure the holes, to accept these bars, the O.D. of the bar plus 1/8" in diameter and 1/2 the length of the bar plus 1" unless otherwise specified by the manufacturer of the adhesive. Use retaining washers (nylon, plastic or composite) on all bars to hold the adhesive material in place. The retaining washers shall be: I.D. = bar O.D., O.D. = hole I.D. + 1/4" min., thickness = 1/16" min. See NCDOT standard drawing 700.01 for bar sizes and other joint related information. Provide adhesive bonding material specified by Section 1081 of the 2012 NCDOT Standard Specifications for Type 3 or 3A adhesives.
3. See typical sections for pavement composition and for other specific information.

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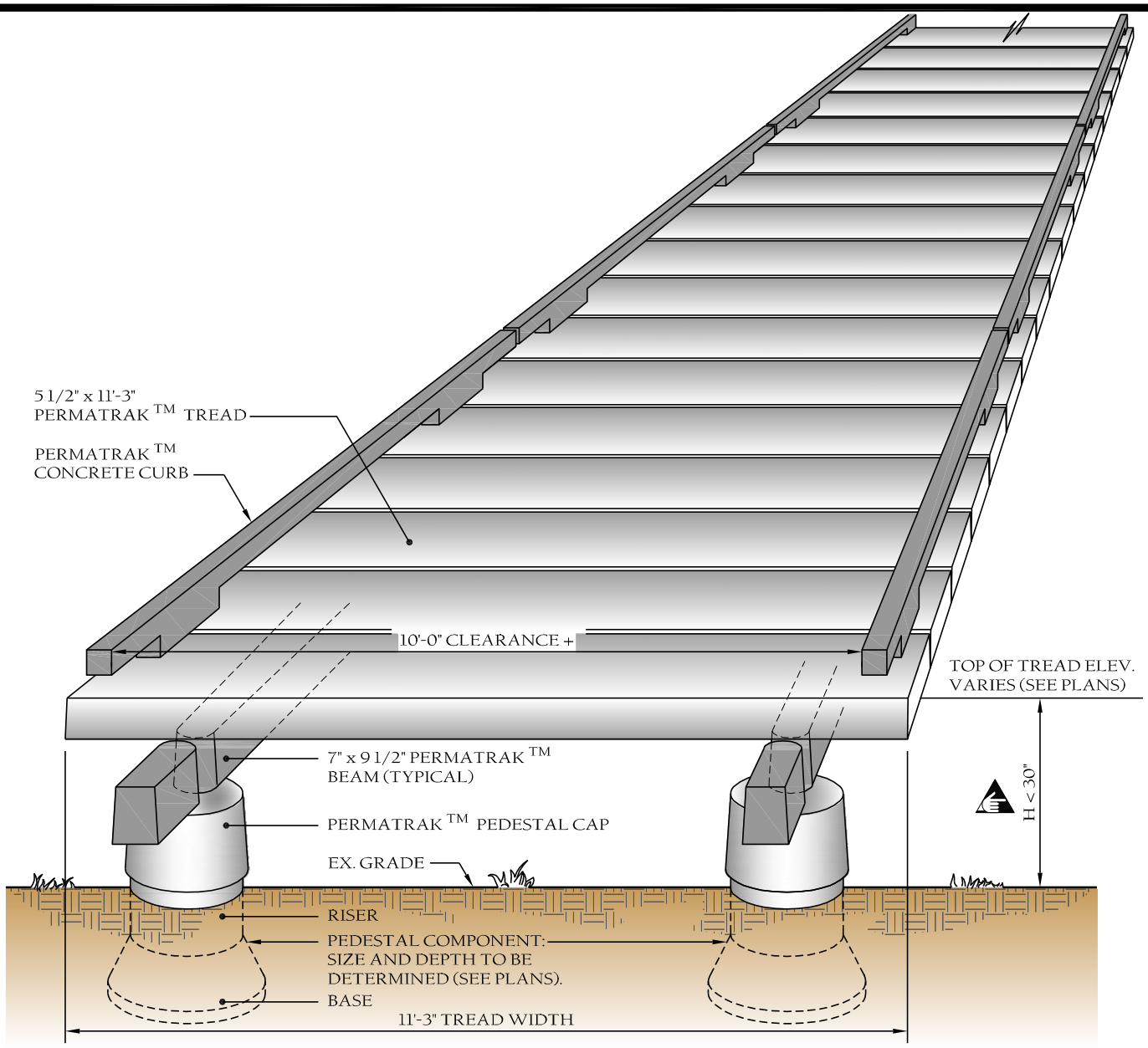
TYING PROPOSED PAVEMENT TO EXISTING PAVEMENT

Scale:	Detail #:
Not To Scale	8.09
Revision Date: Feb., 2015	459



NOTES:

1. PermaTrak foundations may consist of a standard Cap, Riser and Base (as shown on this detail) for shallow bridge clearances. Where wetlands or poor soils are encountered or a greater clearance is necessary requiring the use of piles, the foundation shall consist of pile system comprised of a standard PermaTrak cap placed on top of pilings [Pile type, size and depth to be determined by design engineer]). Coordinate cap/pile connection with manufacturer.
2. PermaTrak boardwalk systems shall be installed per the manufacturer's installation instructions and as shown on the design drawings as approved by the Town's Engineer.
3. Precast abutments either manufactured by PermaTrak or compatible with PermaTrack Beam/Tread must be used at termination ends of boardwalk. Specialized abutment design may be necessary depending on site conditions.
4. Longitudinal beam spans and Base/Riser/Cap spacing shall be determined by analysis and shown on the design drawings.
5. Bases should be set on a prepared subgrade of compacted sand, clean gravel, or concrete per the installation drawings. Bases shall be set level and to the elevation noted on the design drawings. If soft subgrade is encountered, improve as directed by either a Geotechnical Engineer or the project engineer.
6. Precast concrete curbs shall be installed on all elevated boardwalks with a grade separation greater than 4".
7. When the vertical grade separation exceeds 30 inches, hand/guard rails are required (see design manual). In such cases, employ PermaTrak handrail brackets to support/brace handrail posts.
8. All lifting equipment that comes in contact with the precast components should have rubber padding.

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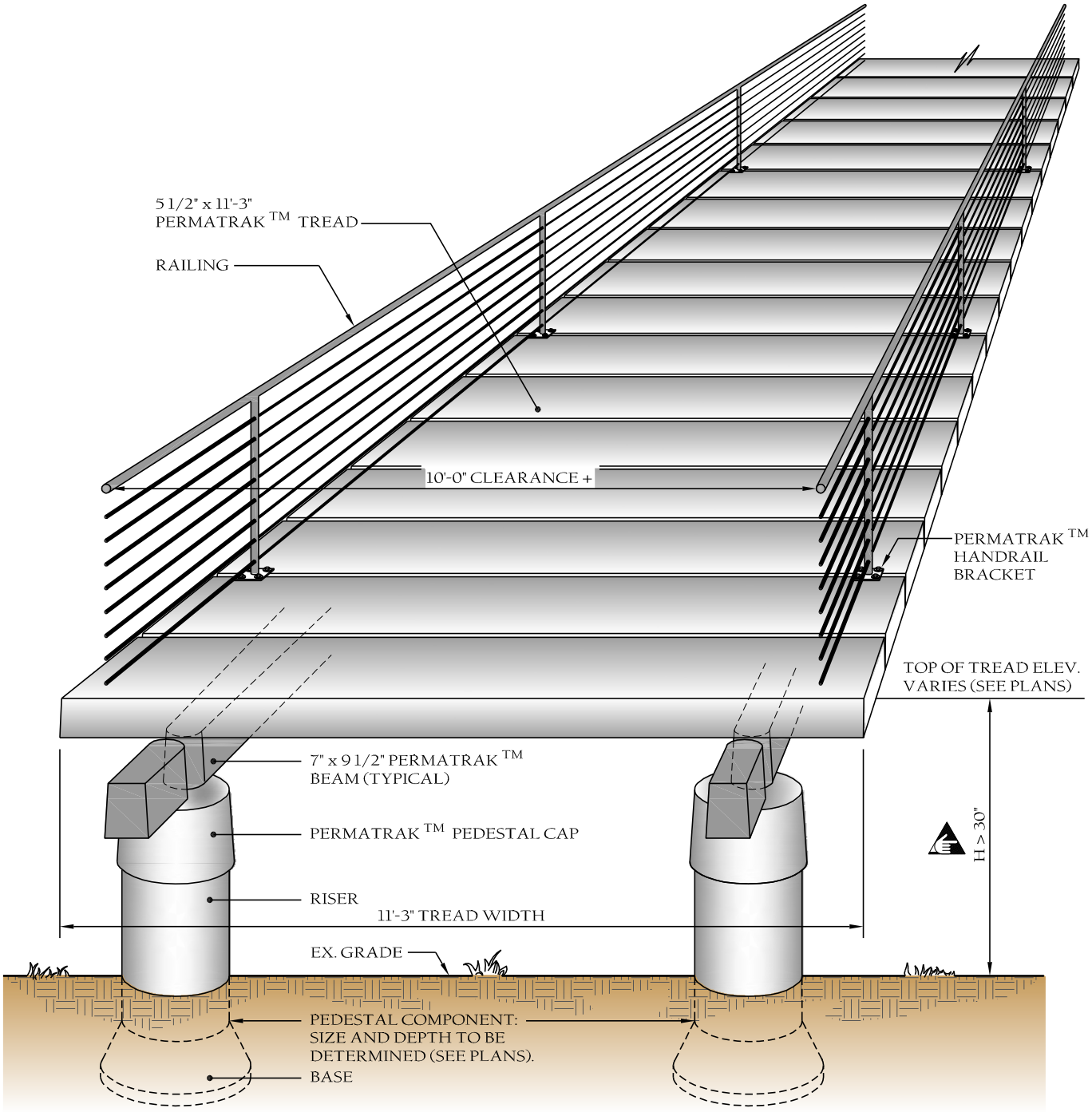
PermaTrak™ ELEVATED BOARDWALK SECTION (HEIGHT < 30")

Scale:	Detail #:
Not To Scale	8.10
Revision Date: Feb., 2015	460



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PermaTrak™ ELEVATED BOARDWALK SECTION (HEIGHT > 30")

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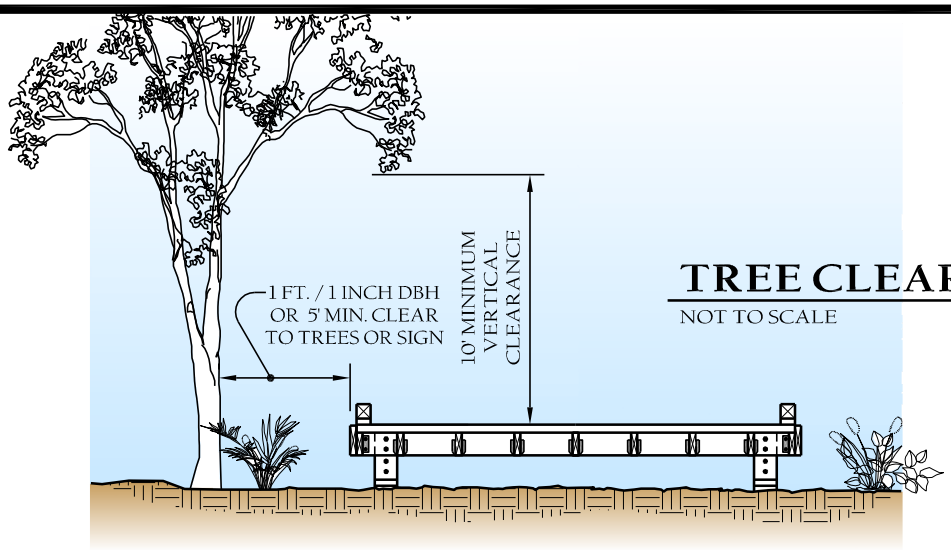
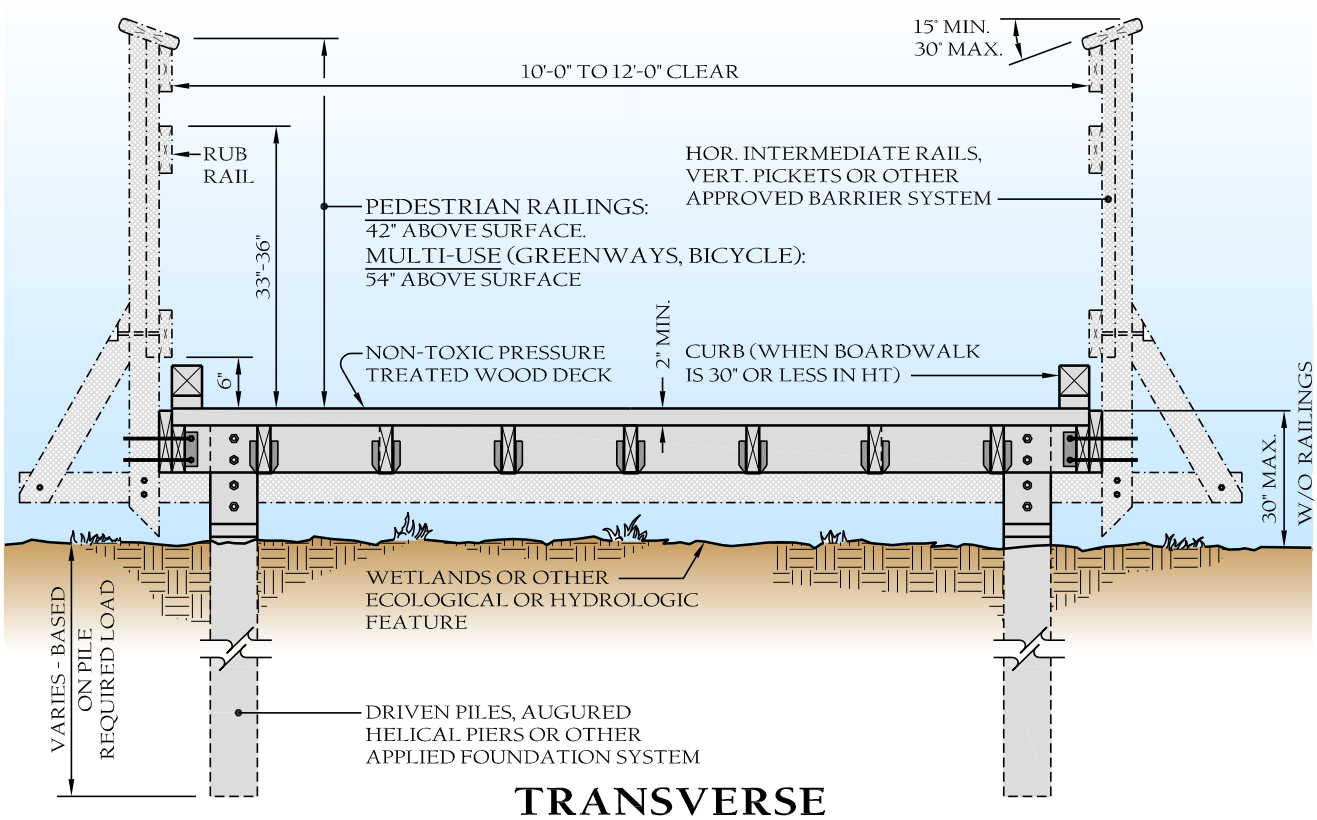
Not To Scale	8.10
Revision Date: Feb., 2015	461



TREE CLEARANCE

NOT TO SCALE



TRANSVERSE BOARDWALK SECTION

NOT TO SCALE

NOTES:

1. *Refer to the Town of Wake Forest Greenway Boardwalk and Foot Bridge Design manual for design criteria.*
2. *When height of boardwalk exceeds 30", designer to evaluate need for lateral bracing.*

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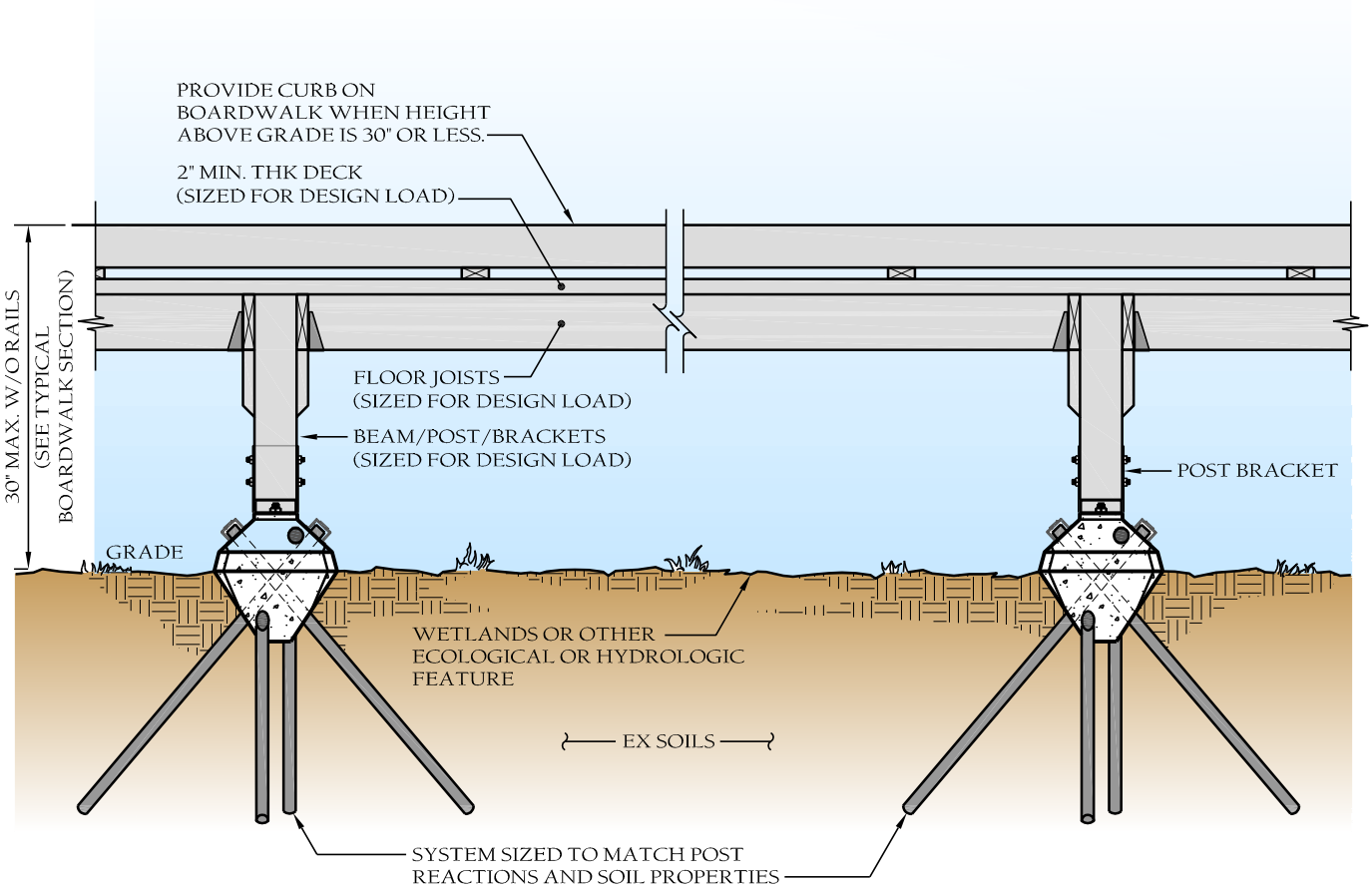
TIMBER BOARDWALK / FOOT BRIDGE CONCEPT OPTION

Scale:	Detail #:
Not To Scale	8.11
Revision Date: Feb., 2015	462



LONGITUDINAL BOARDWALK SECTION SHOWING ALT. FOUNDATION SYSTEM SUPPORTING TIMBER POSTS

NOTES:

1. *Refer to the Town of Wake Forest Greenway Boardwalk and Foot Bridge Design manual for design criteria.*
2. *When height of boardwalk exceeds 30", designer to evaluate need for lateral bracing.*

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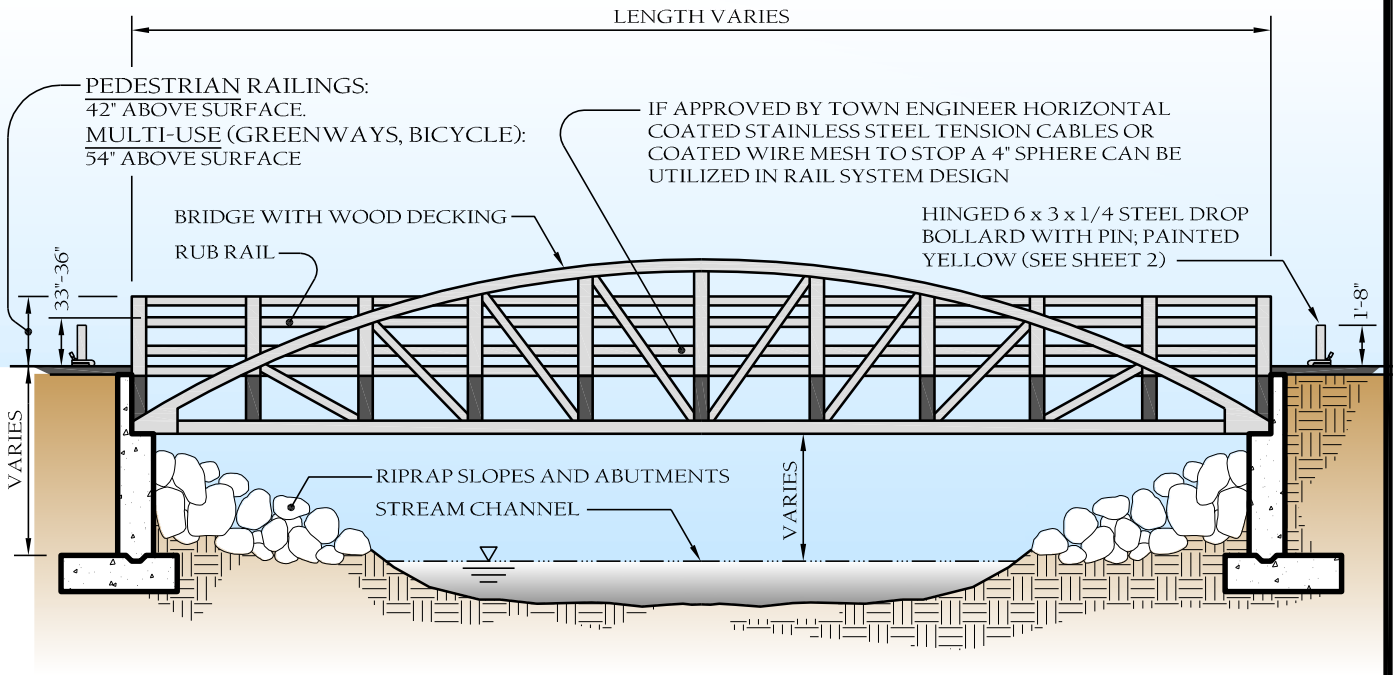
ALT. BOARDWALK / FOOT BRIDGE FOUNDATION SYSTEM

Scale:	Detail #:
Not To Scale	8.12
Revision Date: Feb., 2015	463



NOTES:

1. *Refer to the Town of Wake Forest Greenway Boardwalk and Foot Bridge Design manual for design criteria.*

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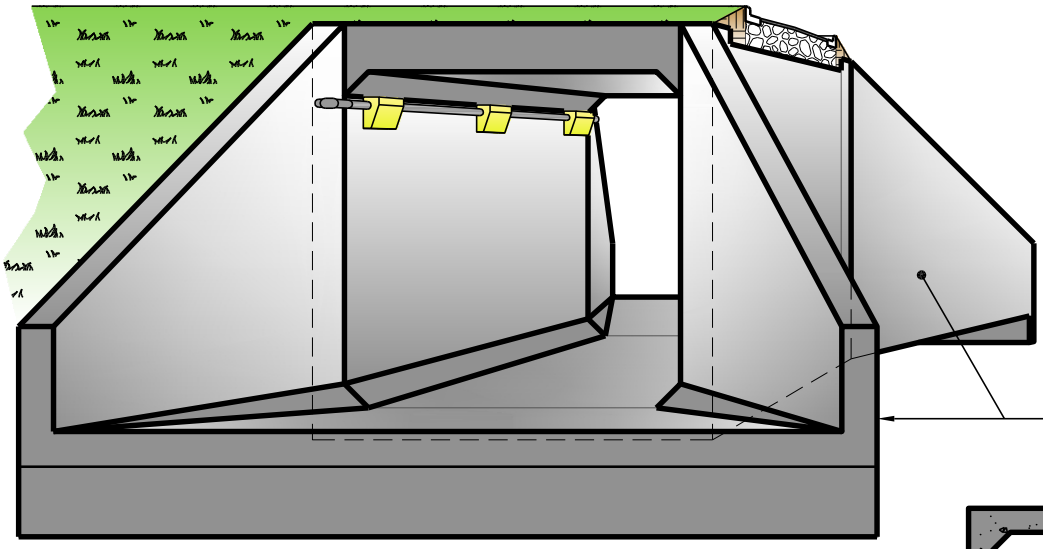
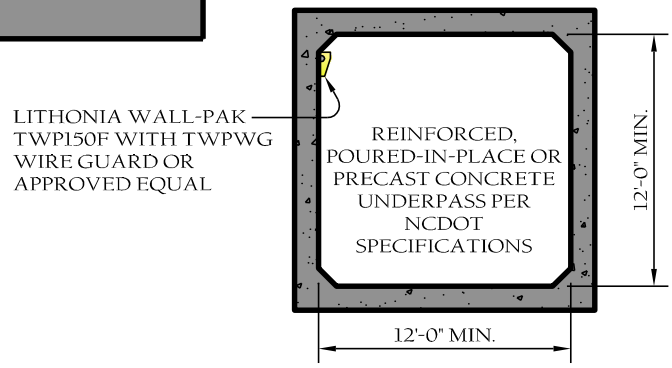
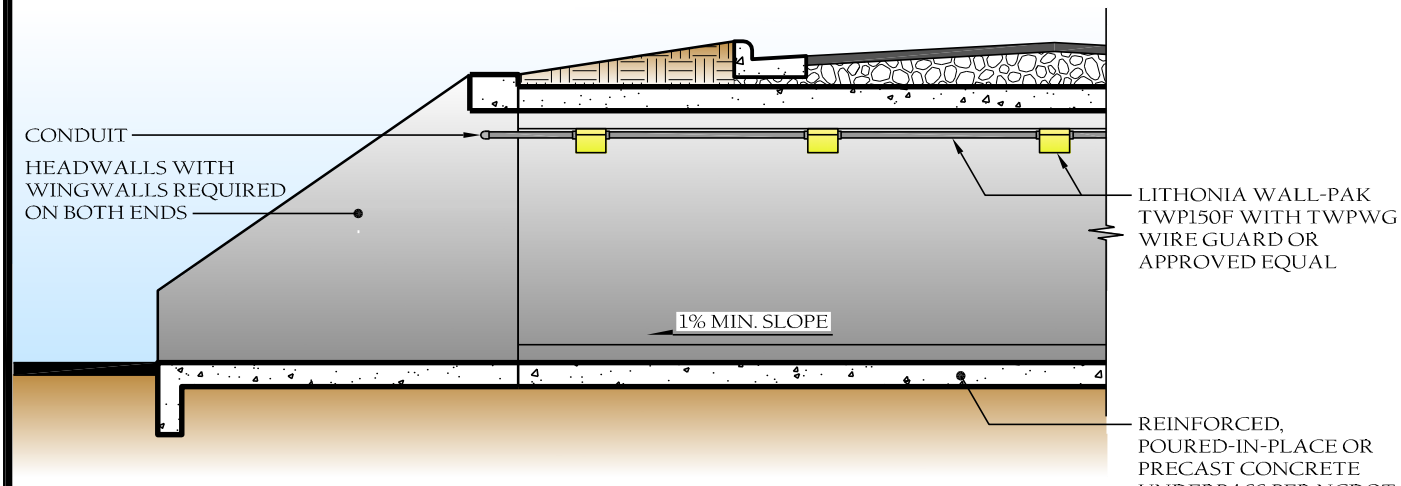
MULTI-USE PATH DETAIL - BOWSTRING PRATT HALF THROUGH TRUSS OPTION

Scale:	Detail #:
Not To Scale	8.13
Revision Date: Feb., 2015	464



FRONT VIEW
(ISOMETRIC)





PARTIAL LONGITUDINAL SECTION

NOTES:

1. Sealing of fixtures to be designed in accordance with IES standards
2. Appropriate signage to be placed at entrance to indicate narrowing trail width if applicable and limited vertical clearance.

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PEDESTRIAN / BICYCLE UNDERPASS

Scale:	Detail #:
Not To Scale	8.14
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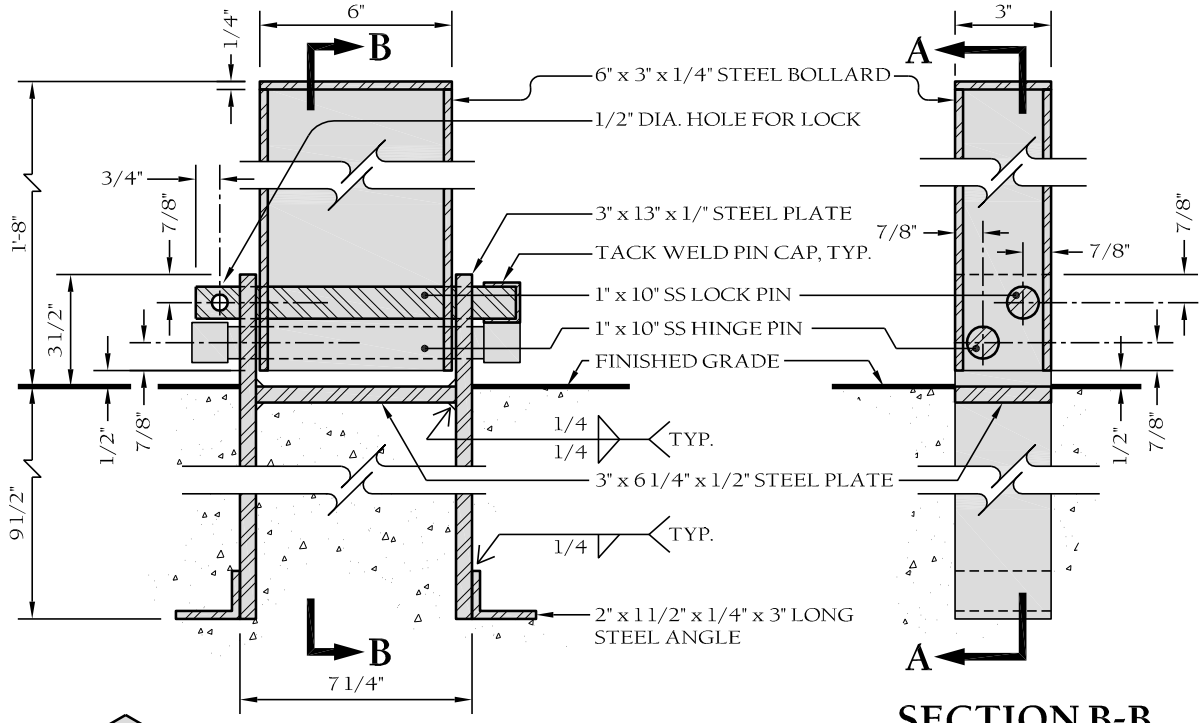
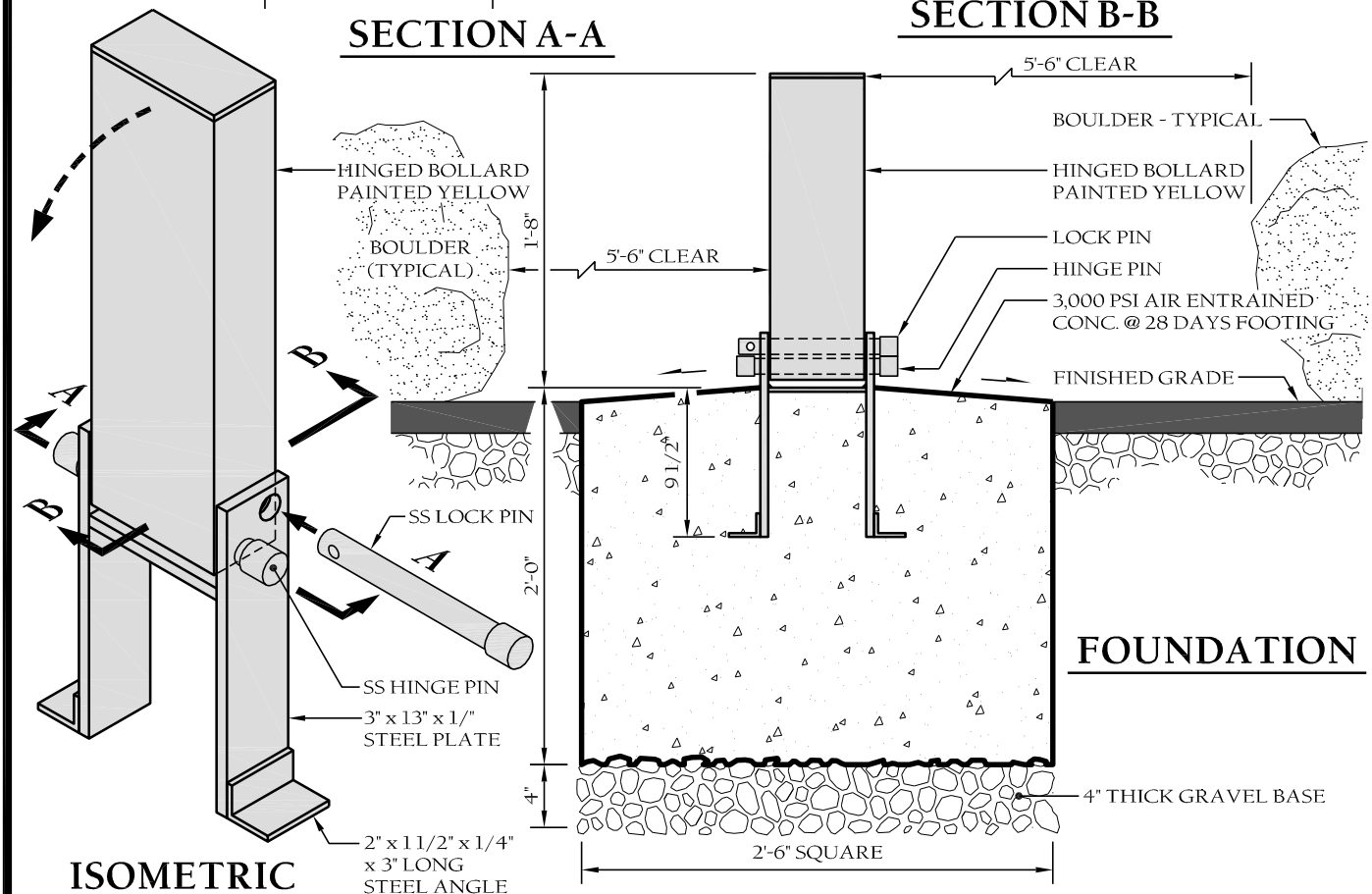


SECTION A-A

SECTION B-B



ISOMETRIC

FOUNDATION

HINGED BOLLARD DETAIL

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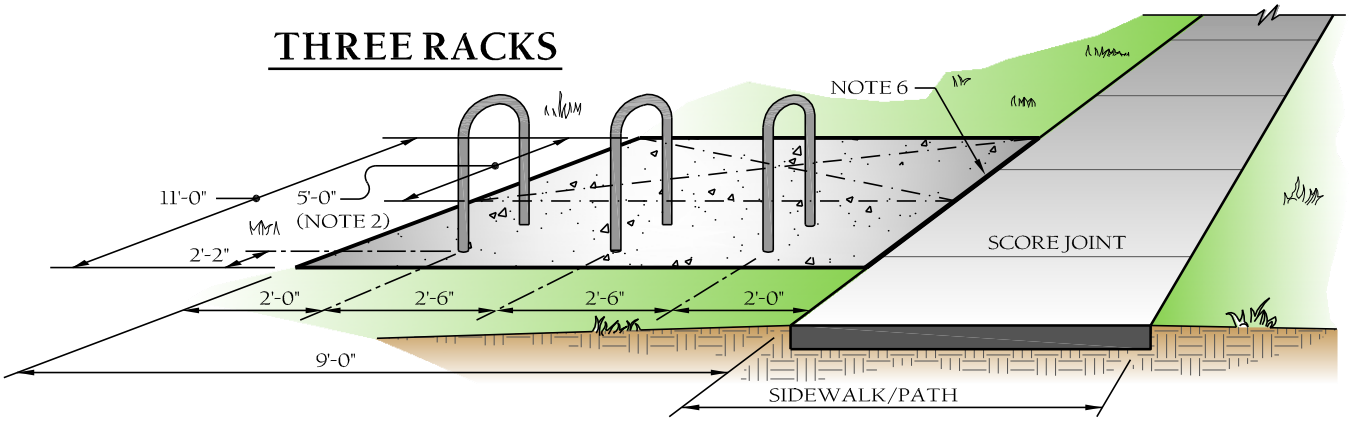
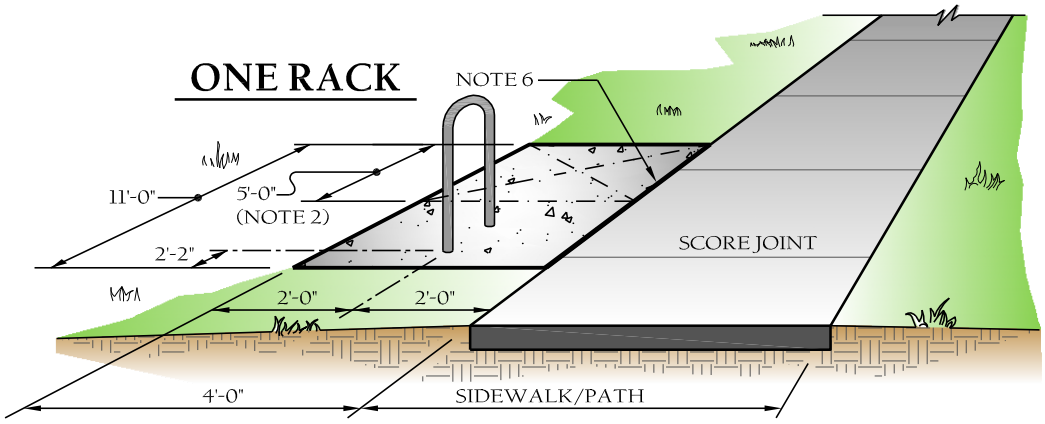
LOW PROFILE HEAVY DUTY HINGED BOLLARD DETAIL

Scale:	Detail #:
Not To Scale	8.15
Revision Date: May, 2014	466

THREE RACKS



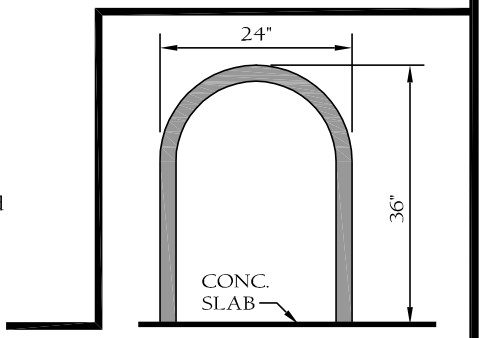
ONE RACK



OPTION 1:
PARALLEL TO SIDEWALK
(PREFERRED)

NOTES:

1. Parking pad to be min. 6" thick, 3,000 psi concrete. Size as shown. (Pad to be min. 4X6 for single rack and 2'-6" additional width per rack, with racks spaced 2'-6" o/c if more than one.)
2. A 5'-0" wide unobstructed maneuvering area is required behind racks when orientated parallel to a sidewalk as shown; requires a min. 4'-0" x 11'-0" pad.
3. Racks shall be flange mounted and shall have black polyester powder coat. Other placements shall meet minimum size requirements.
4. Bicycle parking shall not encroach on accessible paths.
5. Designated placement within parking lots may also be acceptable.
6. Provide expansion joint where concrete pad abuts concrete sidewalk, pad or pathway.
7. Other bike rack designs will be considered upon approval of the Town of Wake Forest Planning Department.



INVERTED "U" RACKS

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BICYCLE PARKING PARALLEL TO SIDEWALK

Scale:	Detail #:
Not To Scale	8.16
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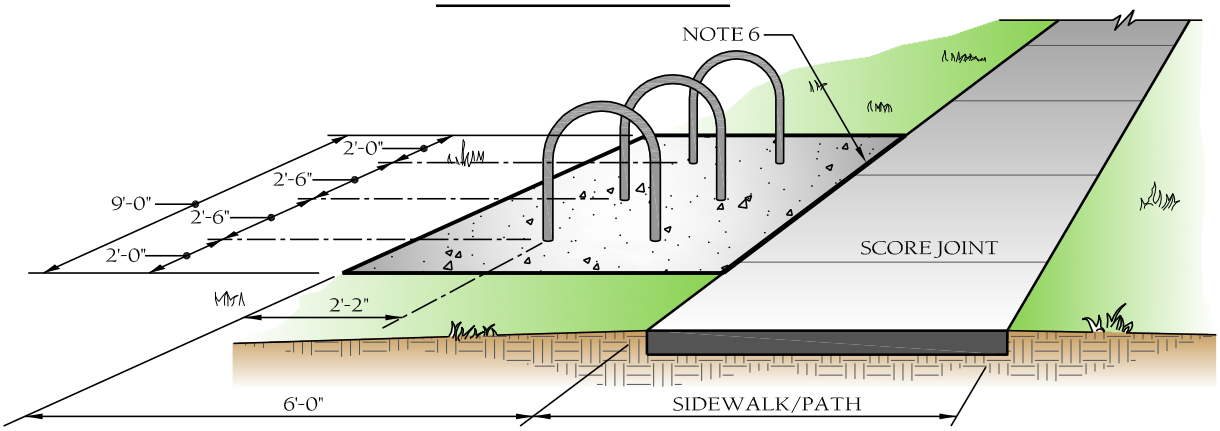
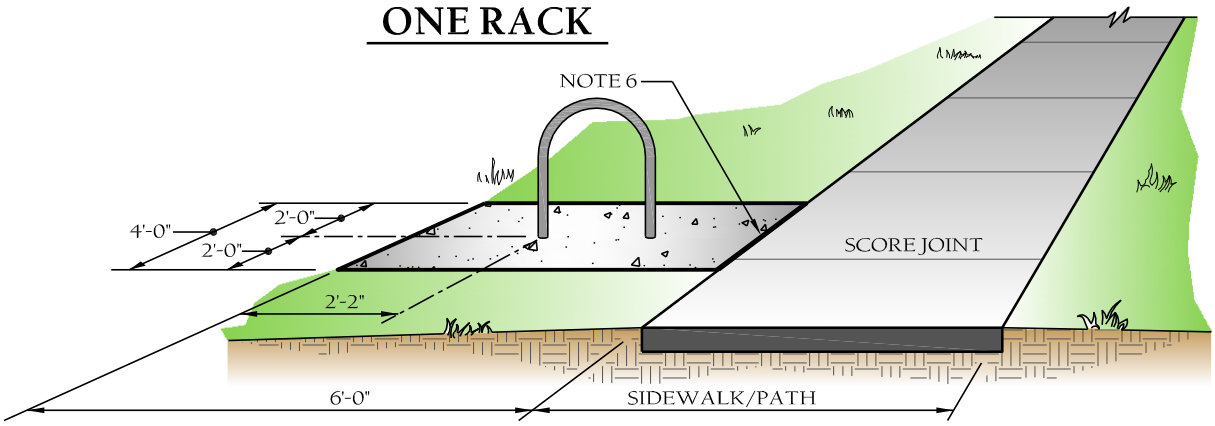
THREE RACKS



ONE RACK



OPTION 2:

PERPENDICULAR TO SIDEWALK
(OPTIONAL)

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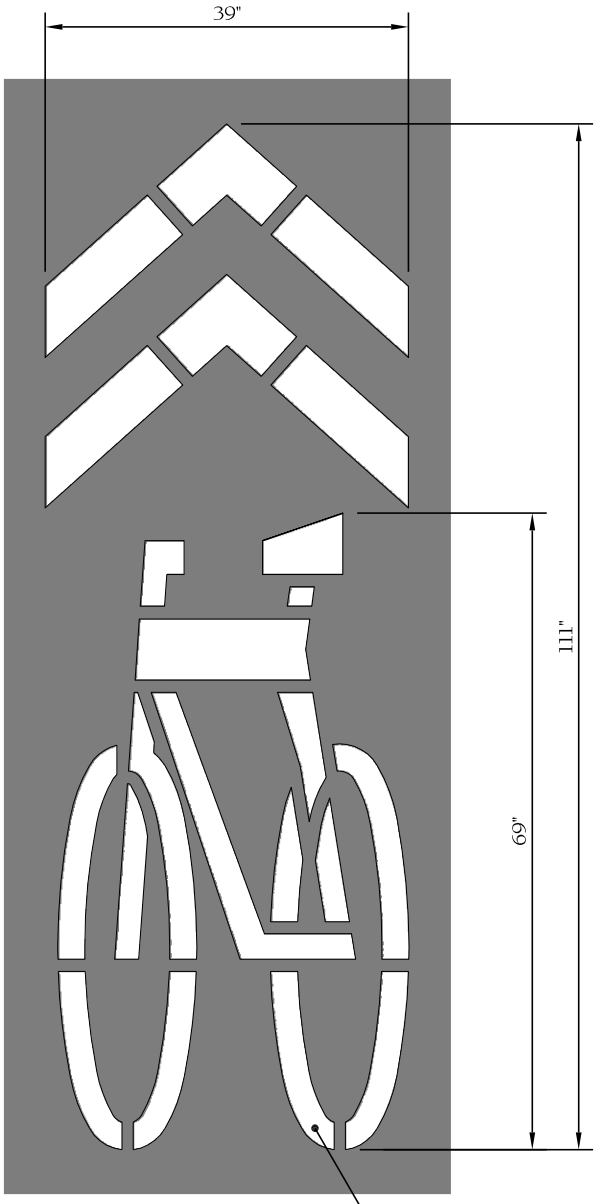
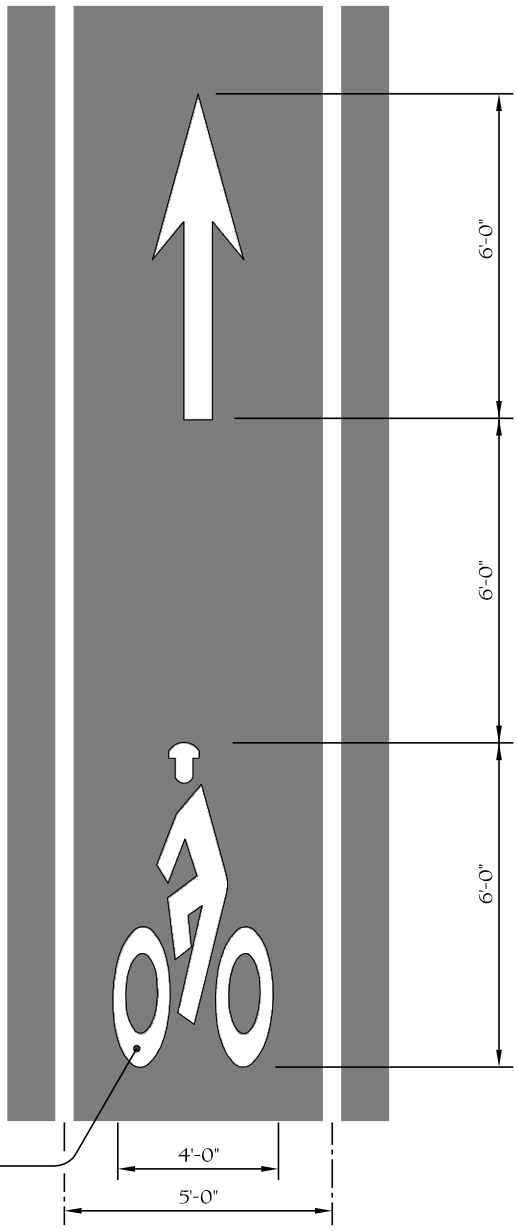
BICYCLE PARKING PERPENDICULAR TO SIDEWALK

Scale:	Detail #:
Not To Scale	8.16
Revision Date: Feb., 2015	468





WHITE REFLECTORIZED PAINT OR THERMOPLASTIC MARKINGS

SHARED BIKE LANE MARKINGS

"SHARROW"

BIKE LANE SYMBOL MARKINGS

TOWN of WAKE FOREST

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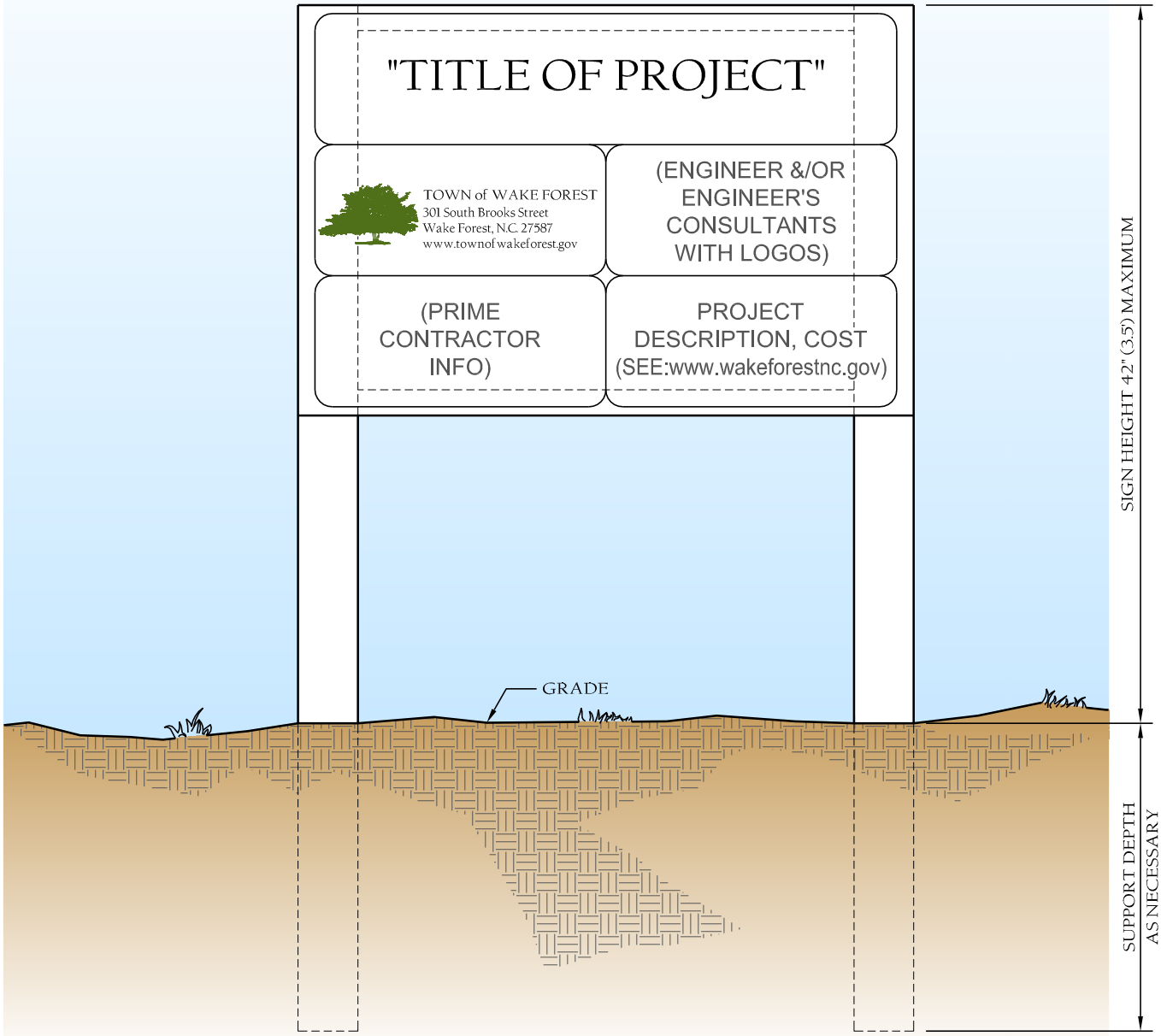
BIKE LANE SYMBOL MARKINGS

Scale:	Detail #:
Not To Scale	8.17
Revision Date: Feb., 2015	469



NOTES:

1. Total sign area = 32 S.F. per side (Maximum).

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PROJECT IDENTIFICATION SIGN for TOWN FUNDED CAPITAL PROJECTS

Scale:	Detail #:
Not To Scale	8.18
Revision Date: Feb., 2015	470

PAVEMENT SECTION MATRIX

UDO Street Type (See UDO paragraph 6.7.2 "Town Street Classifications" for R/W & street cross-section requirements	ADT (vpd)	Minimum Pavement Section					
		SuperPave Asphalt Thickness			Aggregate Base (ABC)	Geogrid [1]	Curb & Gutter [2]
		Riding Surface (S-9.5B)	Intermediate Course (I-19.0B)	Base Course (B-25.0)			
Urban Boulevard (UDO 6.7.2B)	25k to 55k	As Designed	As Designed	As Designed	8	Note 1	Type 3
Avenue (UDO 6.7.2C)	15k to 30k	As Designed	As Designed	As Designed	5	-	Type 2
Commercial Street (UDO 6.7.2D)	10k to 18k	2	-	4	5	-	Type 1
Large Residential Street (UDO 6.7.2E)	2.5k to 15k	2	-	4	5	-	Type 2 or 4
Residential Yield Street (UDO 6.7.2F)	0 to 1k	2	-	-	8	Note 1	Type 2 or 4
Lane (UDO 6.7.2G)	0 to 3k	2	-	-	8	Note 1	Type 1 or 5
Alley (UDO 6.7.2H)	N/A	2	-	-	6	-	N/A
Industrial Access [3]	N/A	As Designed	As Designed	As Designed	8	Note 1	Type 3

1. *For all street classifications within the street right-of-way, the aggregate base thickness may be reduced by 2 inches if an approved Geogrid is installed between the compacted subgrade and the aggregate base. Geogrid to be Tensar BX1100 (SS-2), an approved equal, or as otherwise specified by a NC Licensed PE (Geotechnical Engineer).*
2. *Curb & Gutter Types (see Standard Detail 9.02):*
   - *Type 1 - 30-inch Standard Curb & Gutter.*
   - *Type 2 - 30-inch Standard Curb & Gutter or approved alternate.*
   - *Type 3 - 30-inch Standard Curb & Gutter with 5 inches of ABC below curb and extending a minimum of 6 inches beyond the back of the curb or approved alternate.*
   - *Type 4 - 30-inch Valley Curb.*
   - *Type 5 - LID or Swale.*
3. *Right-of-way and street section to be as required by Town Engineer.*
4. *Street pavement sections must be designed using the procedures outlined in the UDO, Section 3, Street and Subdivision Design, paragraph 3.3 Pavement Design Methods except that individual elements shall not be less than shown in the above table.*
5. *See UDO Section 6, Infrastructure Standards, paragraphs 6 5.3 Pedestrian/Bicycle Connections, 6.7.2 Town Street Classification, 6.8 Sidewalk and Other Pedestrian Facilities and 6.9 Bikeway Facilities for sidewalk and bikeway requirements.*

Notes:

1. *Sidewalk and curb to be 3000 psi at 28 days air entrained concrete. Sidewalk to be scored every 5 ft with 1/2" expansion joints at 30 ft intervals. Provide non-slip finish. Concrete sidewalks to be 4" except thickness to increase to 6" at all driveway crossings and for a distance 5' either side of the driveway. Place 1/2" expansion joints at junction of 4" and 6" sidewalks.*
2. *Maximum grades and "K" valves for streets shall follow NCDOT guidelines for the Piedmont area (rolling topography). See Table 9.03.*
3. *All pavement thickness' shall generally be confirmed by a geotechnical investigation and report. However, if a developer wishes, he may design residential streets using a subgrade CBR one standard deviation to the left of the average of all CBR's determined by geotechnical reports thus far. If, in the opinion of the Town's representative, soils appear weaker or have inherent problems such as a high mica content, the services of a geotechnical engineer shall be required in any case for the design of pavements.*
4. *Electric service will not go in until street section is graded at final and approved.*
5. *The Town Engineer shall require a 1" overlay over any segment of street in which there are 3 or more trench failures, utility cuts, egregious imperfections or patches per 800 foot of street. If final surface is already placed, it must be milled down so as not to encroach into the gutter pan. A trench failure shall be defined as a depression of 1/2" or greater at the deepest point over a trench width. Extent of length of resurfacing shall be as determined by the Town's Engineer.*
6. *Time limits for completion of improvement: Refer to UDO Section 6.38.*

Concrete Testing Requirements:

Initial Test

The initial test (from first ready-mix truck) is to be taken after the second yard is dispatched from the mixer and is to consist of the following:

1. *One slump test*
2. *Pull, prepare and store 3 cylinders on-site for 24 hours.*
3. *Temperature*

Subsequent Tests

After the above tests are pulled from the initial truck, every 5th truck thereafter is to be tested in the same manner as noted above.

Asphalt Testing Requirements:

Compaction: *Testing for asphalt density is to follow NCDOT "Standard Specifications for Roads and Structures", Section 609-7 "Field Compaction Quality Control" and Section 609-9, "Quality Assurance" latest revision.*

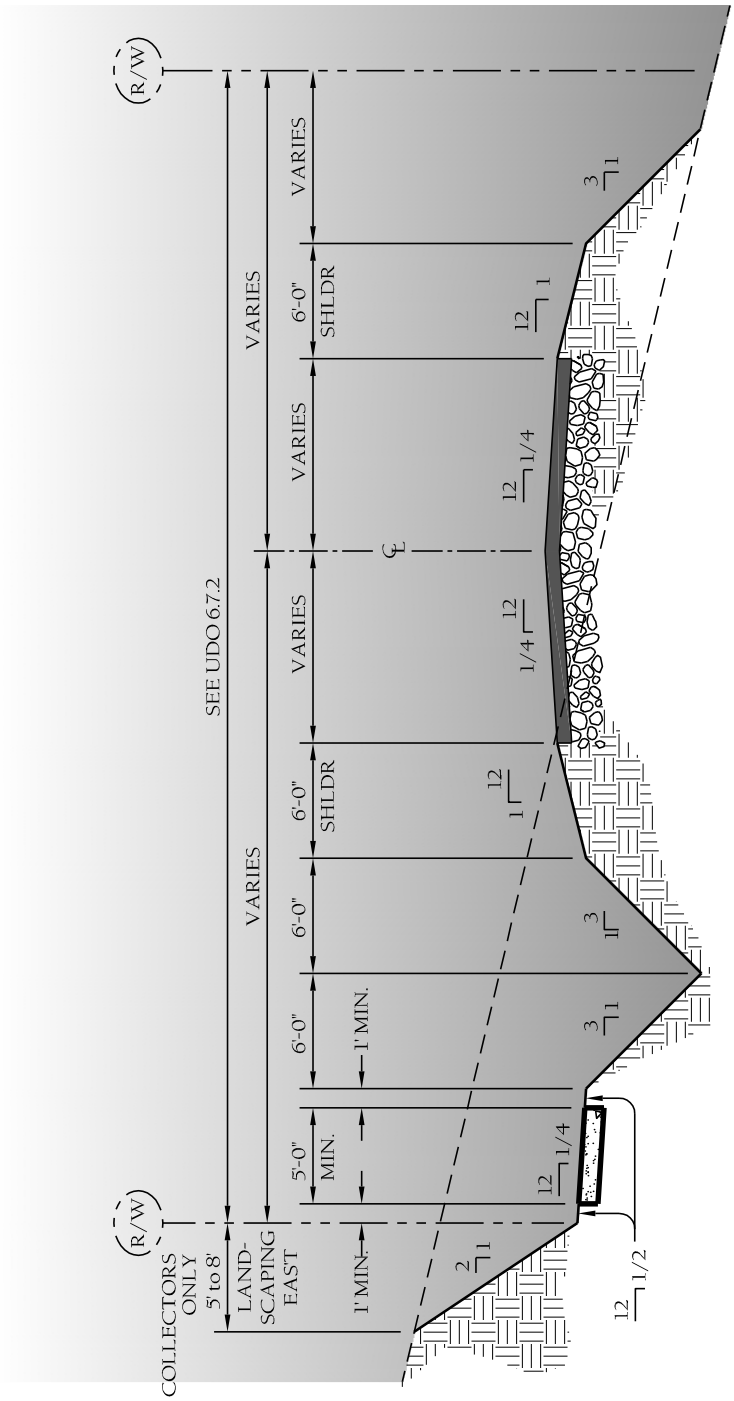
Thickness: *The minimum frequency of coring for thickness testing shall be on the basis of test sections consisting of not more than 1500 linear feet of lay down width, exclusive of intersections and irregular areas. The test sample is to be a 6-inch cored sample. The sample is to be numbered and logged for identification purposes.*

Contractor's Quality Control System:
Follow NCDOT "Standard Specifications for Roads and Structures", Section 609-4 "Contractor's Quality Control Personnel Requirements" and Section 609-5, "Contractor's Quality Control Field Laboratory Requirements," latest revision.

Mixture and Job Mix Formula Adjustments:
Follow NCDOT "Standard Specifications for Roads and Structures", Section 609-3. "Field Verification of Mixture and Job Mix Formula Adjustments", latest revision.

General: *All other applicable sections of Section 609 of the NCDOT "Standard Specifications for Roads and Structures" shall apply relating to Quality Control Plan, mix design, control limits, corrective action, equipment and measurement.*

Testing Cost: *Project Owner is responsible for cost of testing.*



APPLIES TO STREET WHERE SIDE WALK IS REQUIRED

TOWN of WAKE FOREST

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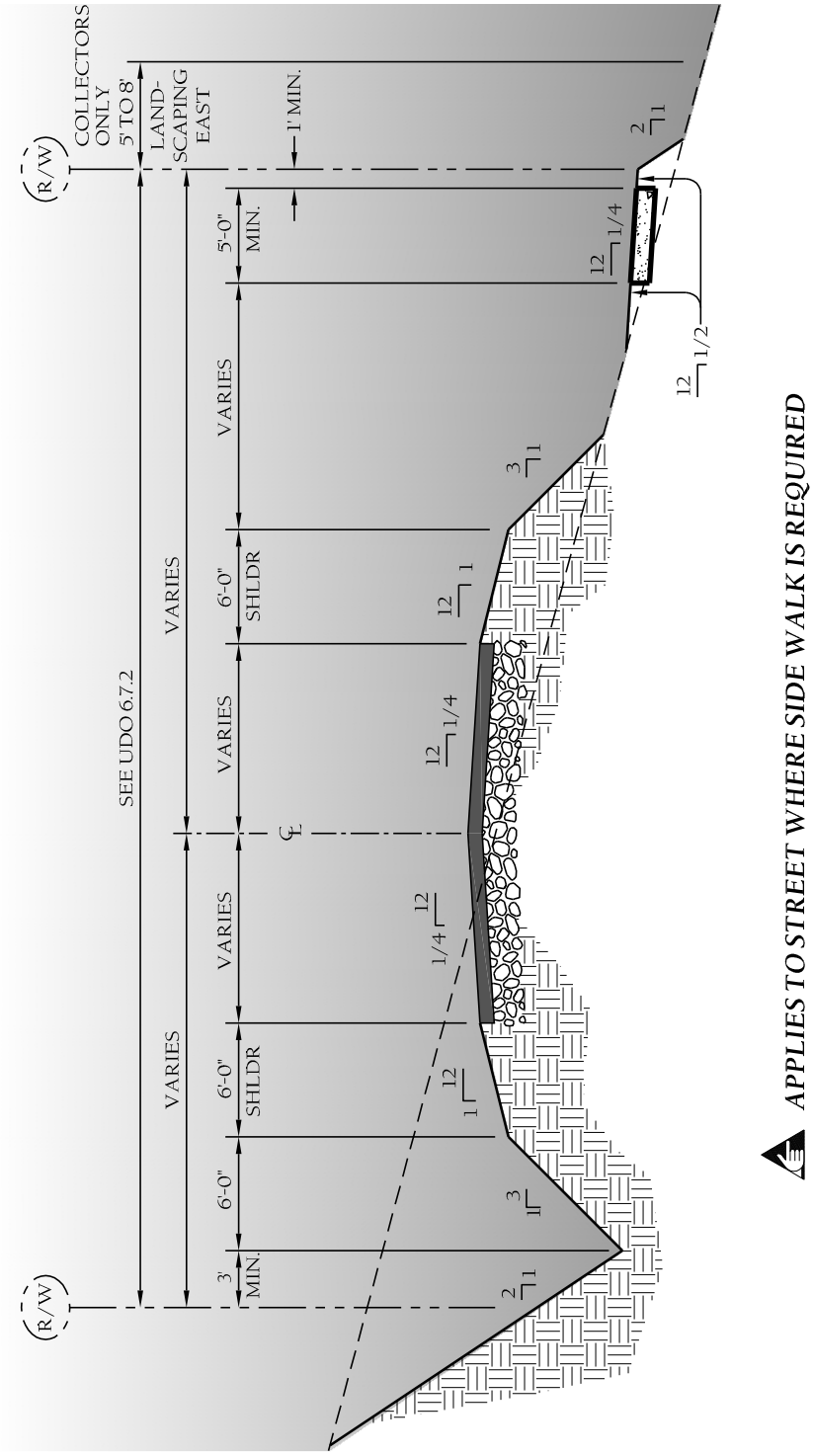
TYPICAL ASYMETRIC X-SECTION WITH SIDEWALK (ON CUT SLOPE)

Scale:	Detail #:
Not To Scale	9.01A
Revision Date:	Sheet #:
Feb., 2015	1 of 2



APPLIES TO STREET WHERE SIDE WALK IS REQUIRED

TOWN of WAKE FOREST

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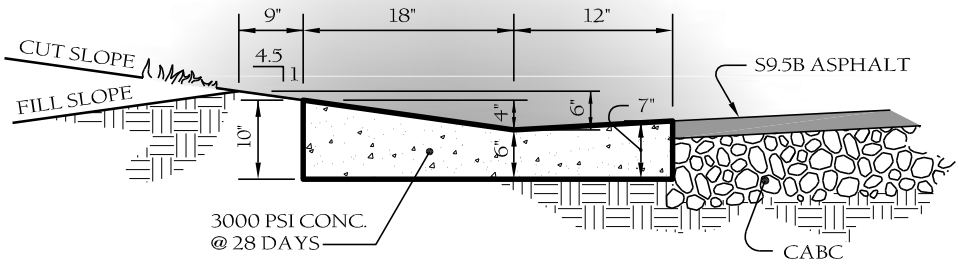
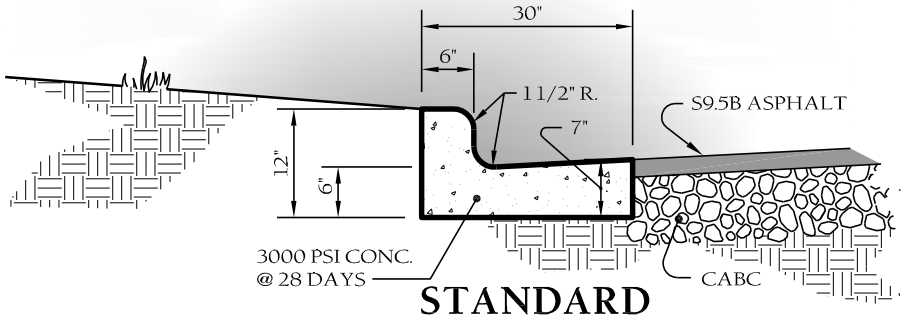
TYPICAL ASYMETRIC X-SECTION WITH SIDEWALK (ON FILL SLOPE)

Scale:	Detail #:
Not To Scale	9.01A
Revision Date:	Sheet #:
Feb., 2015	2 of 2



30" VALLEY - STANDARD



STANDARD

NOTES:

1. *Score curb / valley gutter at 15' O.C.*
2. *Provide 1/2" expansion joints at 90' O.C.*
3. *For transition of curb to curb opening inlet, see standard detail 9.50*

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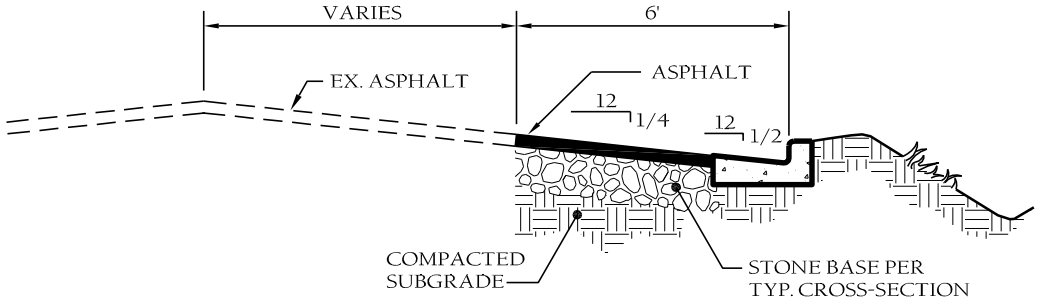
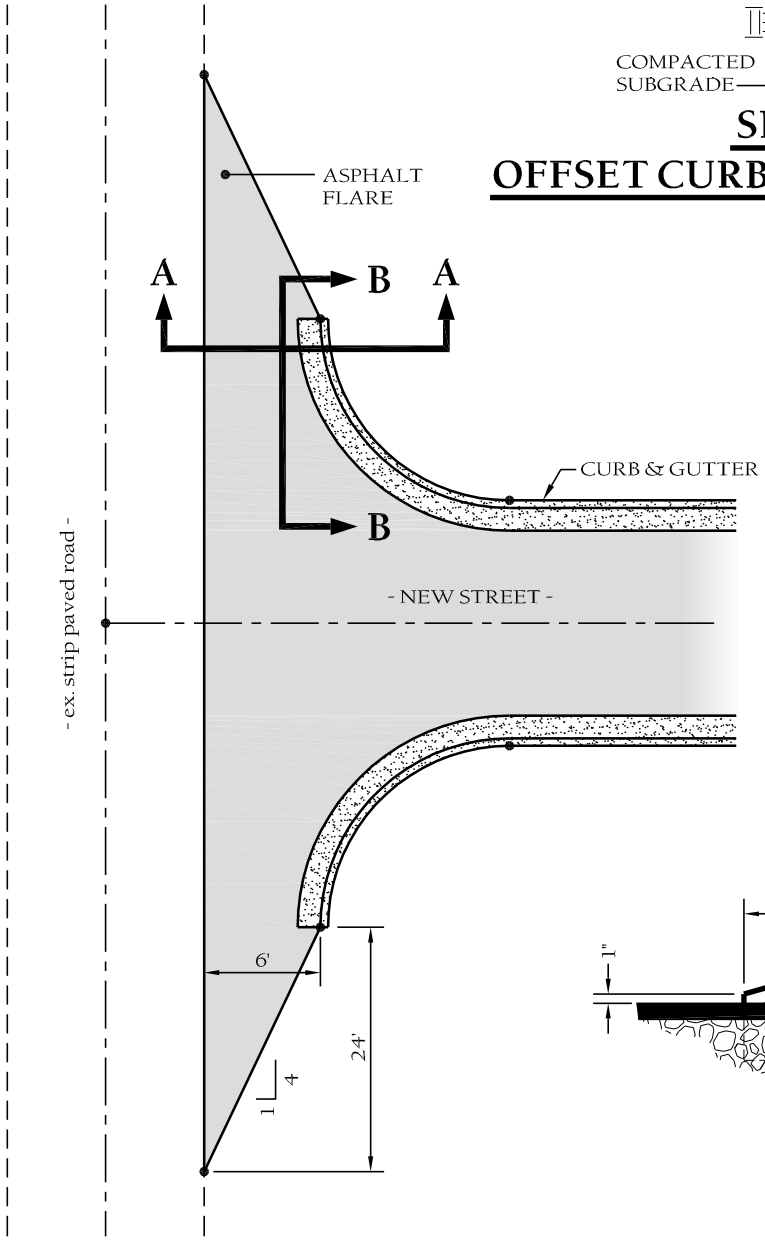
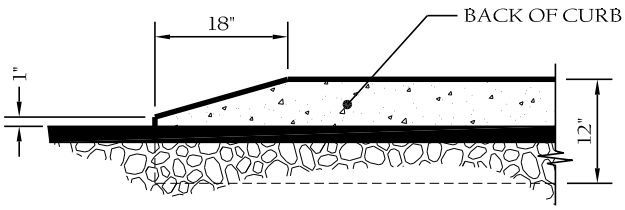
STD. CURB & GUTTER & VALLEY GUTTER DETAIL

Scale:	Detail #:
Not To Scale	9.02
Revision Date:	Sheet #:
Feb., 2015	1 of 1



SECTION A-A
OFFSET CURB PAVEMENT WIDENING





SECTION B-B
CURB END TAPER

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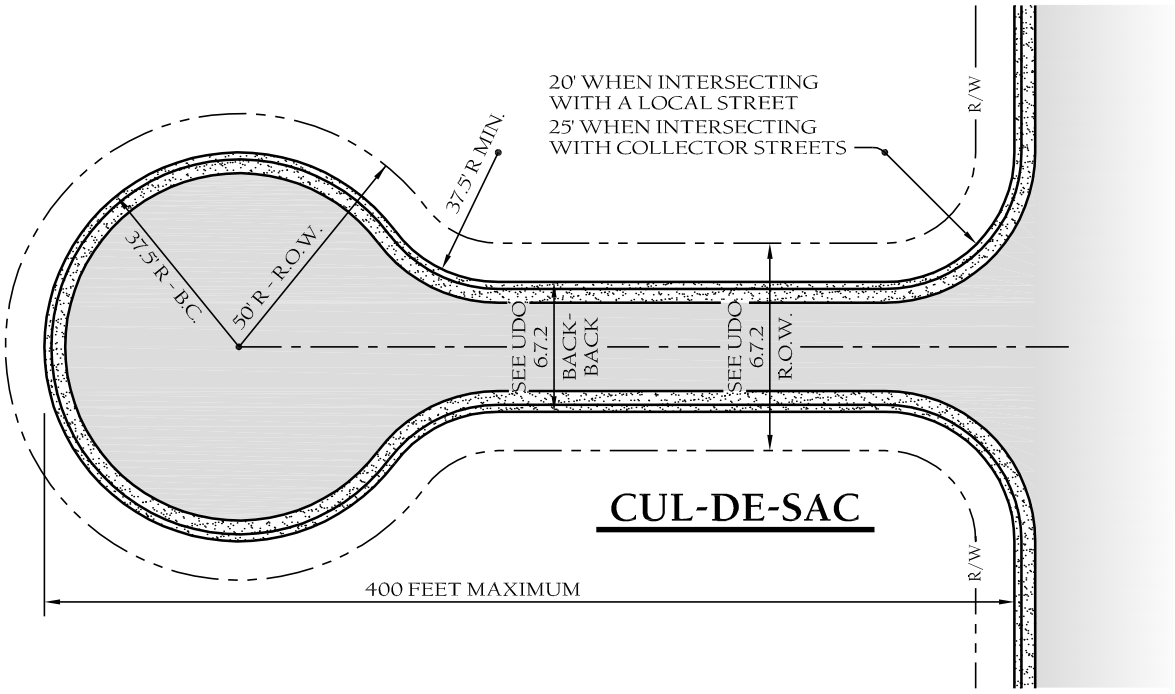
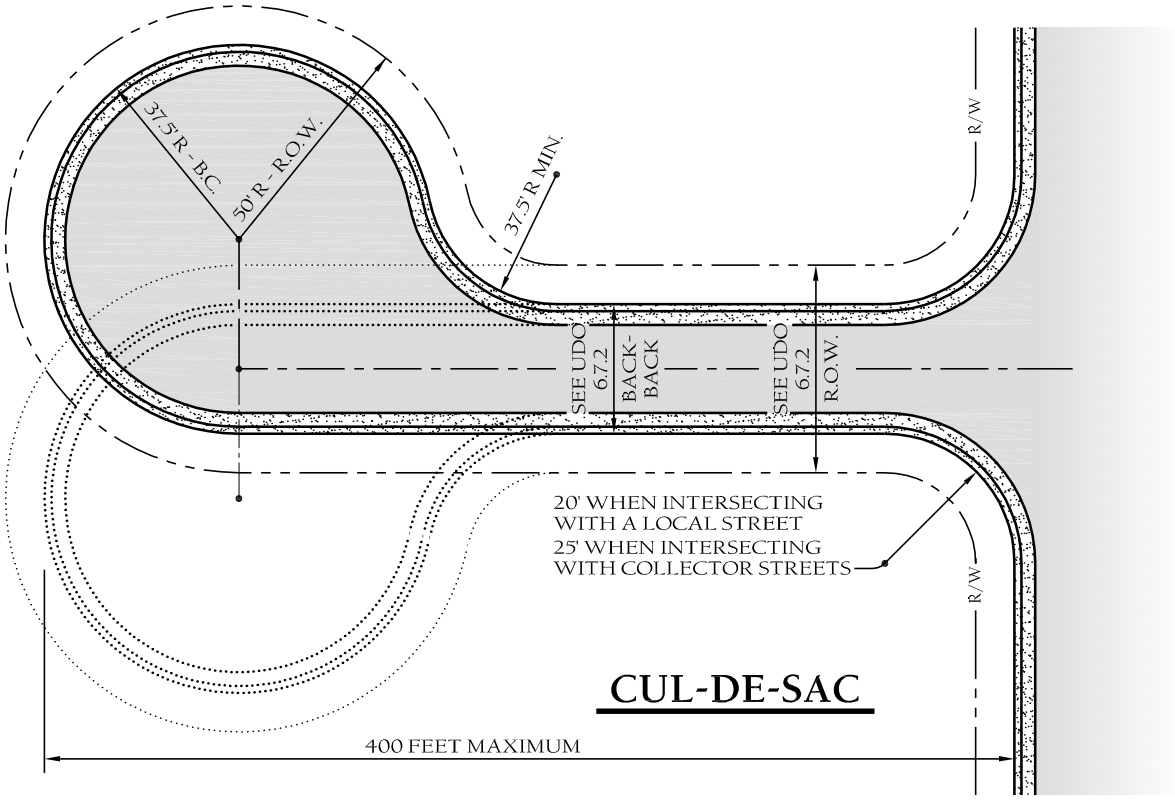
TERMINAL END OF CURB at SHOULDER SECTIONS

Scale:	Detail #:
Not To Scale	9.03
Revision Date:	Sheet #:
Feb., 2015	1 of 1





NOTES:

1. *See UDO 6.7.2 for pavement and right-of-way dimensions.*

TOWN of WAKE FOREST

TOWN of WAKE FOREST, NC

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CUL-DE-SAC DIMENSIONS

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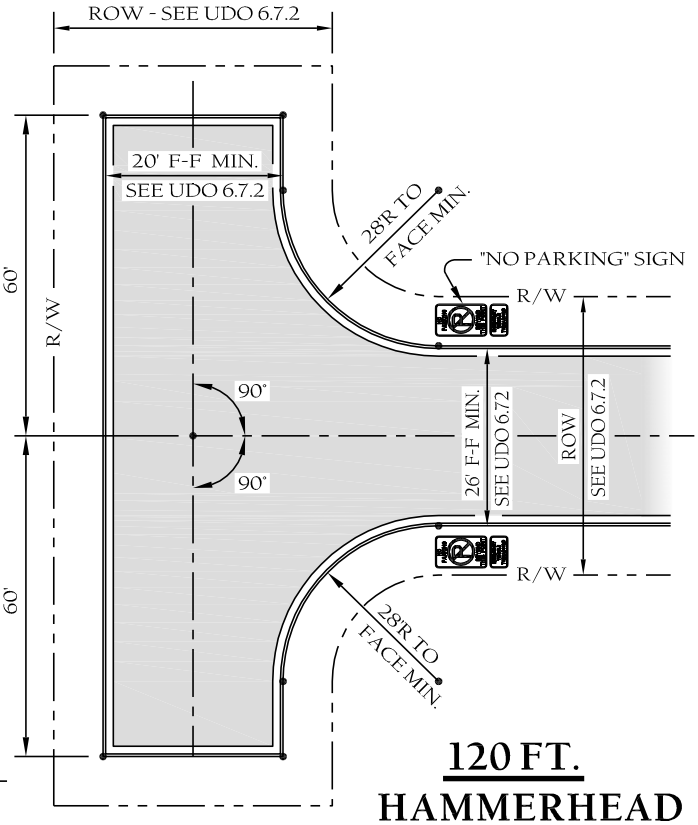
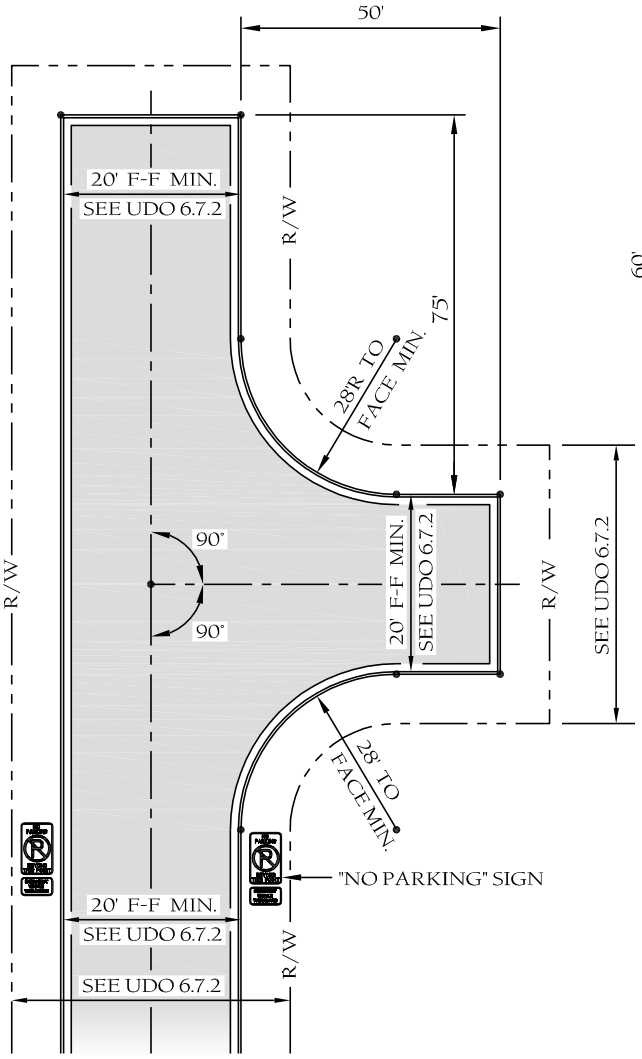
ROW = RIGHT OF WAY



120 FT. HAMMERHEAD



ALTERNATE TO 120 FT. HAMMERHEAD

NO PARKING SIGN

NOTES:

1. *See UDO 6.7.2 for pavement and right-of-way dimensions.*
2. *Ref: N.C. Fire Code Appendix B.*

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CUL-DE-SAC DIMENSIONS

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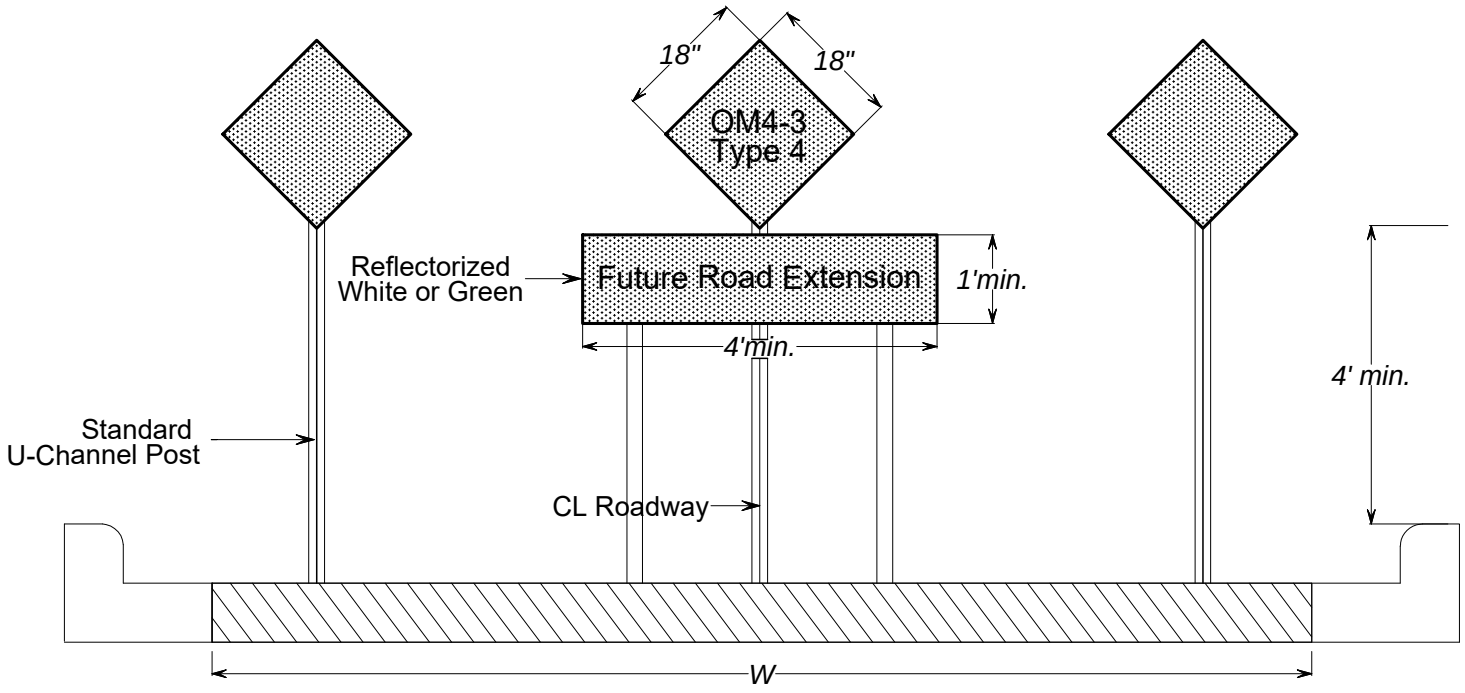

Notes:

1. OM4-3 signs should be evenly spaced between curb and gutter.
2. Spacing shall be adjusted for wider roadways. Additional signage may be required.
3. Advance warning sign W14-1 (Dead End) shall be placed after last intersection.
4. If subdivision has no additional exits, advance signage shall be placed at entrance(s).

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END OF ROAD SIGNAGE

Scale Not To Scale	Detail # 9.05
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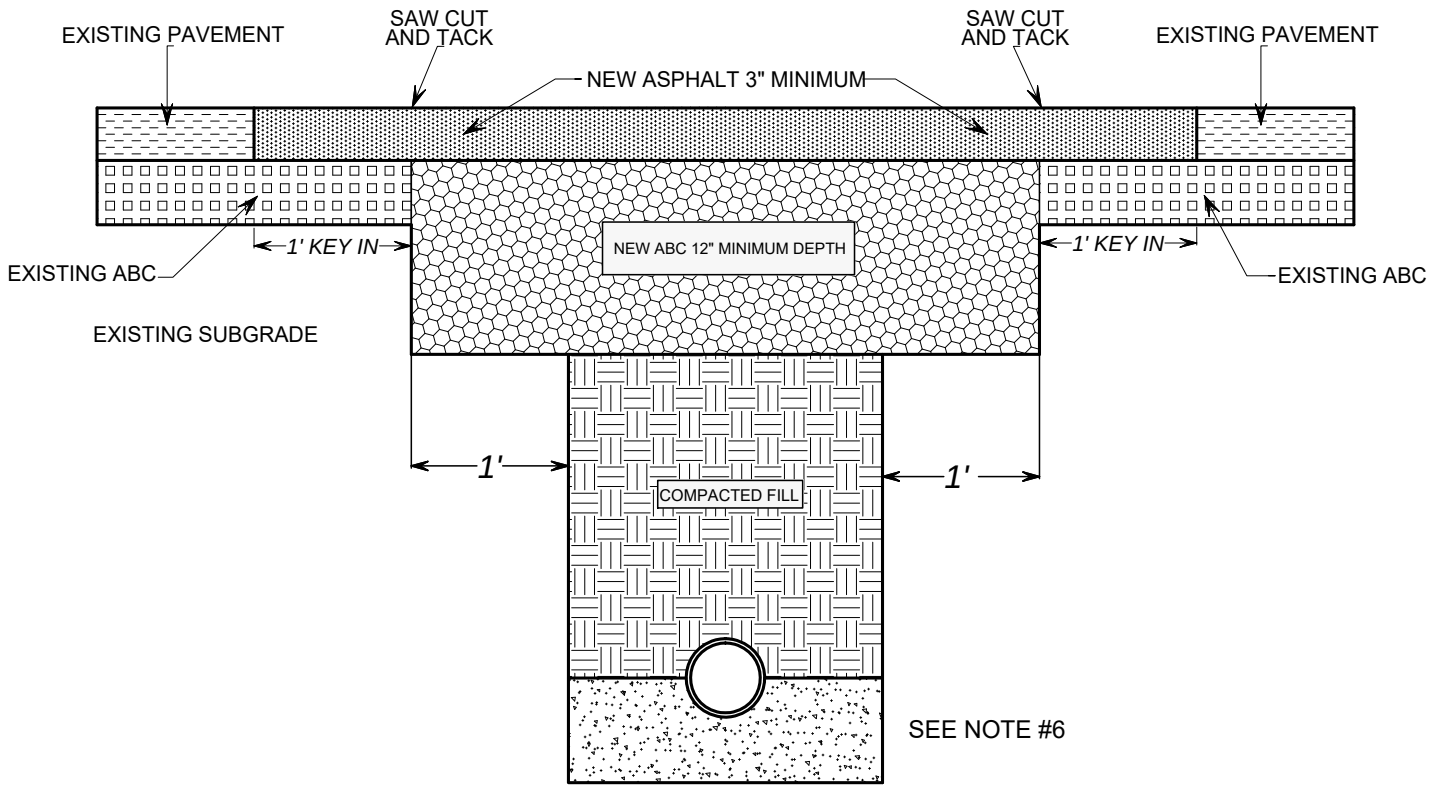

Notes:

1. Trench is to be backfilled in 6” lifts with suitable material and compacted to a density of at least 95% asdetermined by AASHTO test method T-99.
2. The final 1’ of fill shall consist of ABC material compacted to a density equal to 100% as determined by AASHTO test method T-80. Bituminous base or binder may be supplemented with the approval of the Transportation Engineer.
3. The entire existing depth of pavement shall be sawcut, clean of any debris, and tacked prior to paving.
4. The same depth of pavement material shall be reinstalled to match what exists. In no case shall the asphalt be less than 3” thick.
5. Patch shall be installed and compacted to provide a smooth and even transition.
6. For RCP 36” or greater, #57 washed stone shall be installed to the spring line prior to backfill.
7. All density tests may be required to be performed in the presence of a Town Construction Inspector.
8. For small, non-compactable holes, flowable fill may be required

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Full Depth Asphalt Repair Detail For Utility Cuts	Scale Not To Scale	Detail # 9.06
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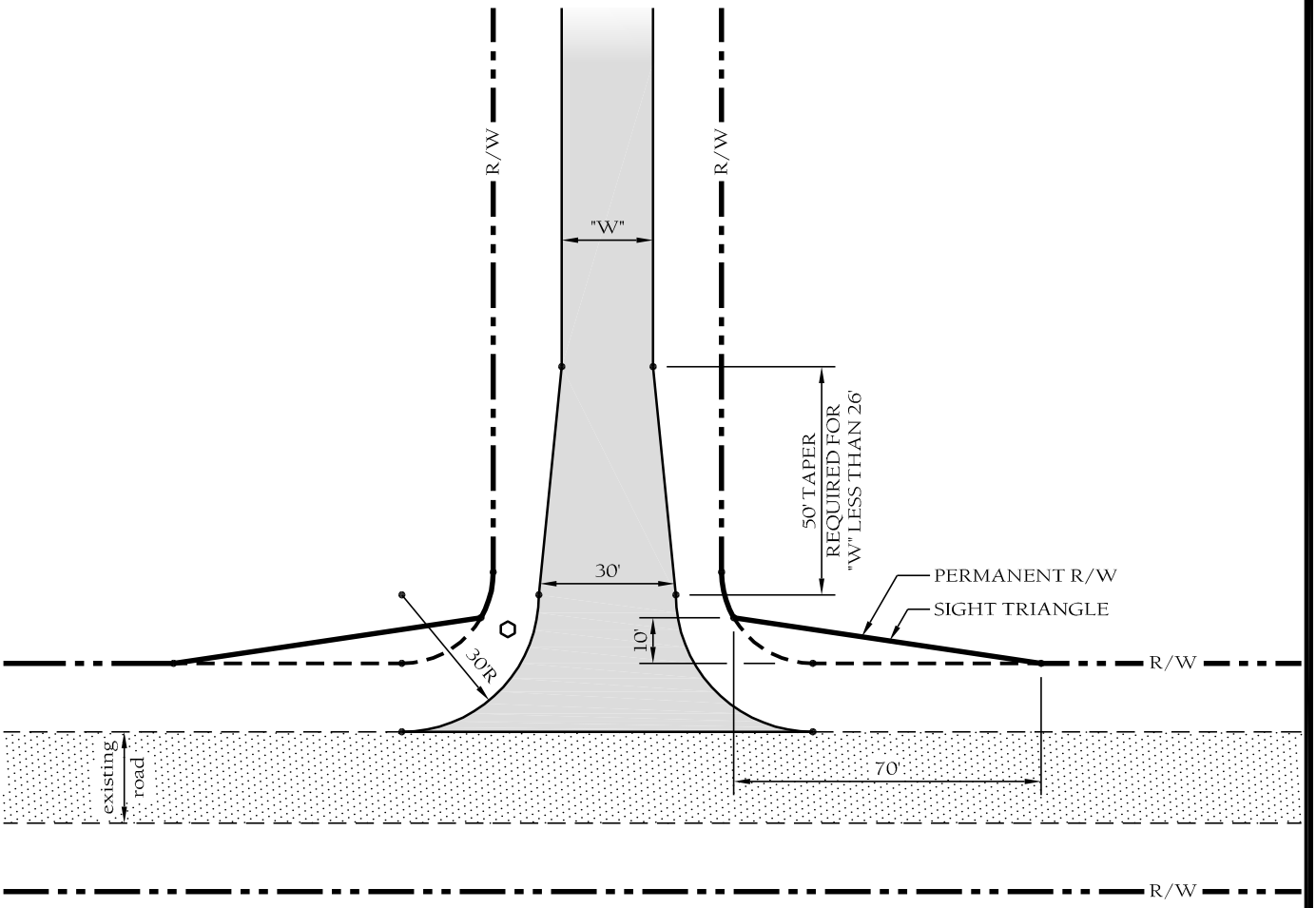

TOWN of WAKE FOREST

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TIE-IN OF STREETS at DOT SHOULDER ROADS - STREETS

Scale:	Detail #:
Not To Scale	9.07
Revision Date:	Sheet #:
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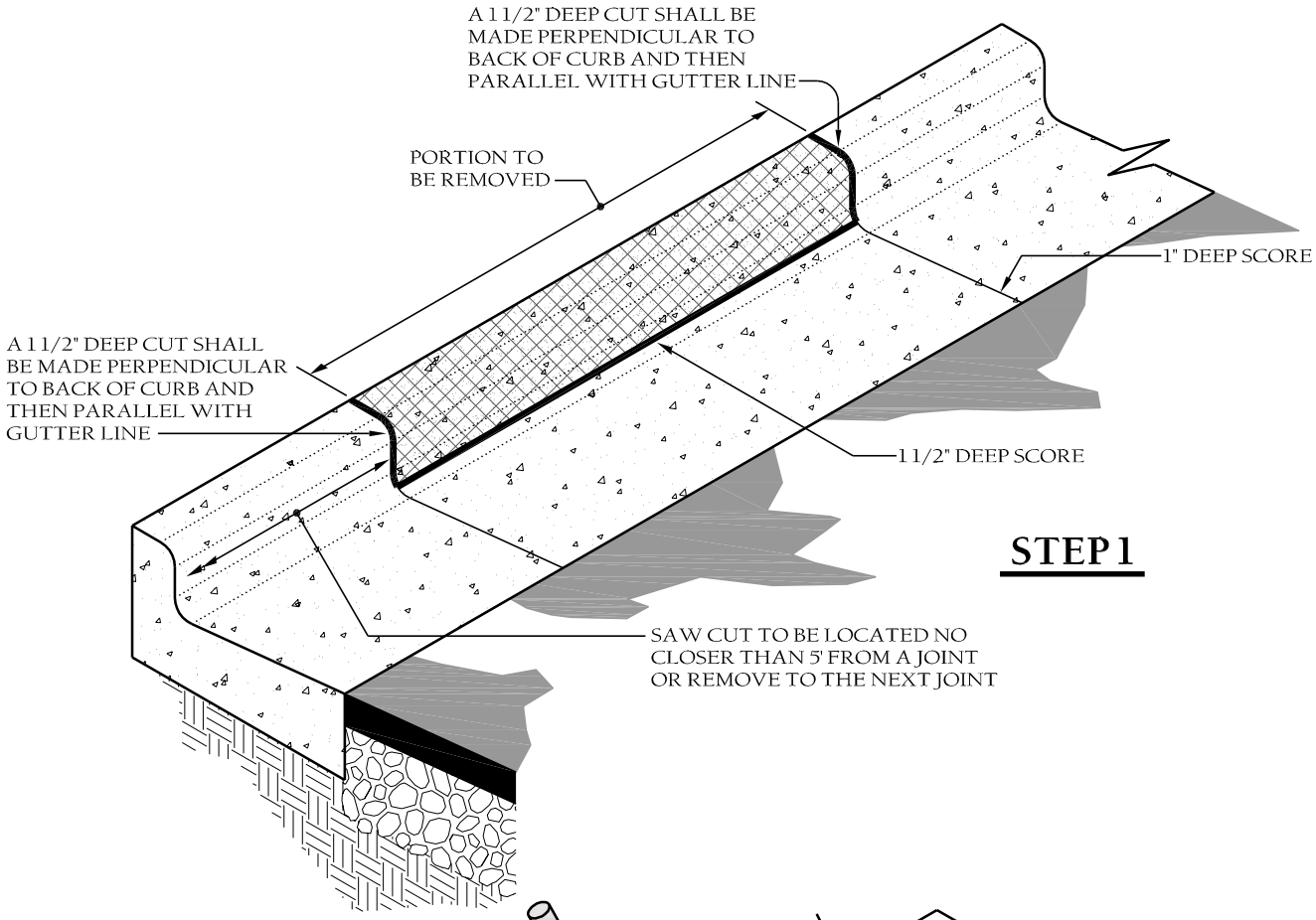

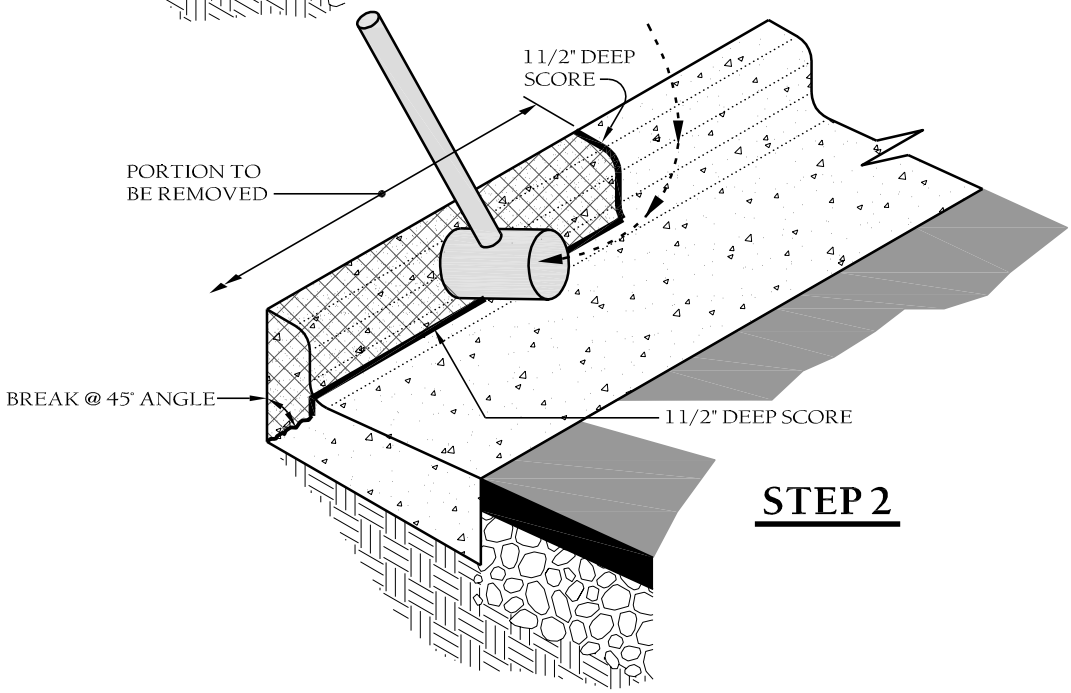

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STREET CURB CUT FOR DRIVEWAYS ON C&G STREETS

Scale:	Detail #:
Not To Scale	9.08
Revision Date:	Sheet #:
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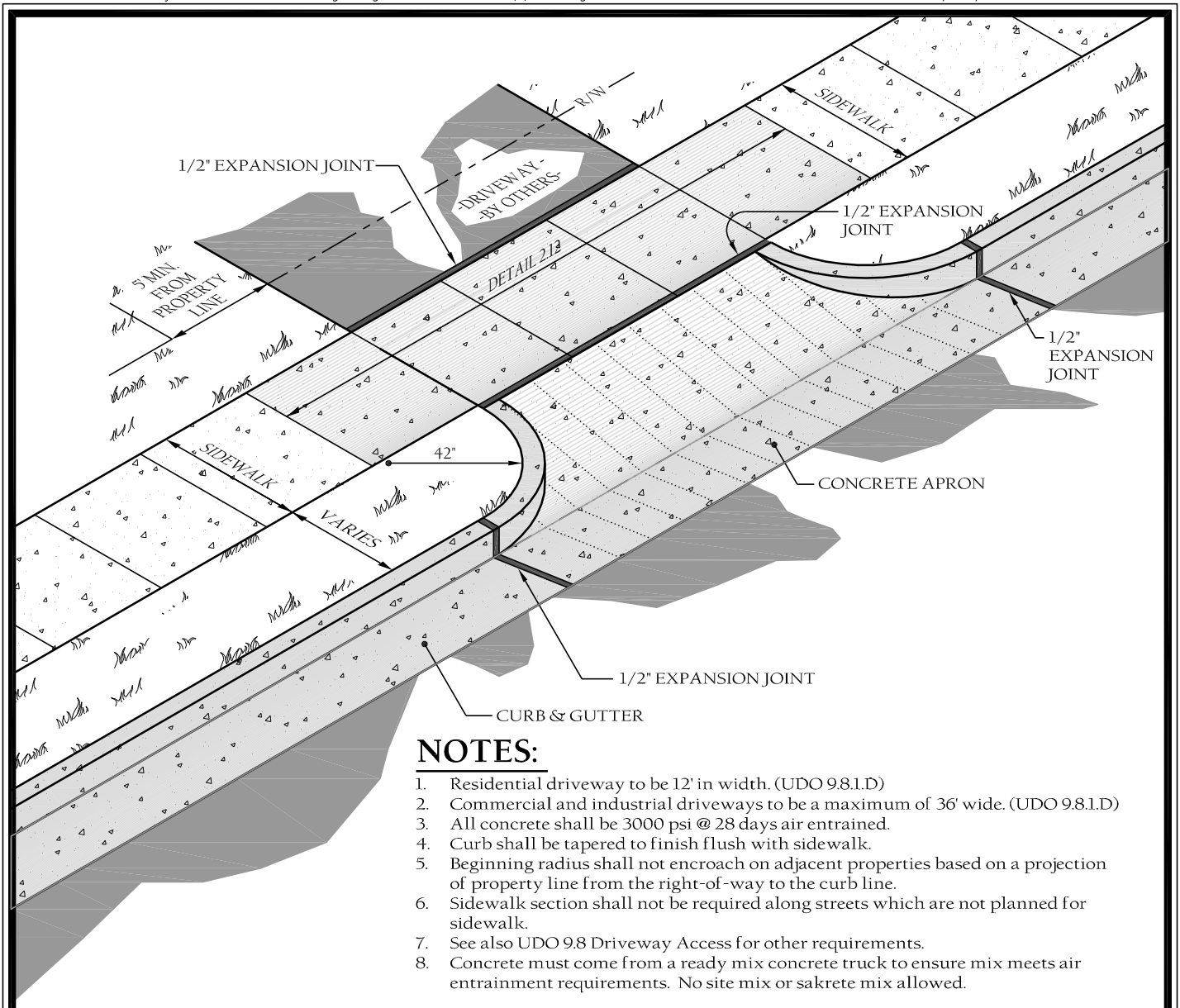
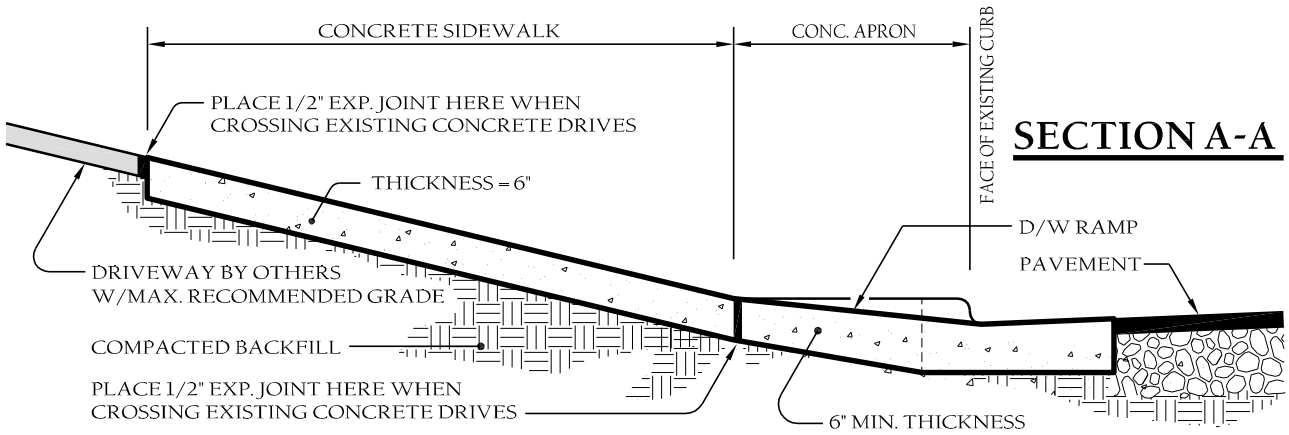


NOTES:

1. Residential driveway to be 12' in width. (UDO 9.8.1.D)
2. Commercial and industrial driveways to be a maximum of 36' wide. (UDO 9.8.1.D)
3. All concrete shall be 3000 psi @ 28 days air entrained.
4. Curb shall be tapered to finish flush with sidewalk.
5. Beginning radius shall not encroach on adjacent properties based on a projection of property line from the right-of-way to the curb line.
6. Sidewalk section shall not be required along streets which are not planned for sidewalk.
7. See also UDO 9.8 Driveway Access for other requirements.
8. Concrete must come from a ready mix concrete truck to ensure mix meets air entrainment requirements. No site mix or sakrete mix allowed.



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STREET CURB CUT FOR DRIVEWAYS ON C&G STREETS

Scale:	Detail #:
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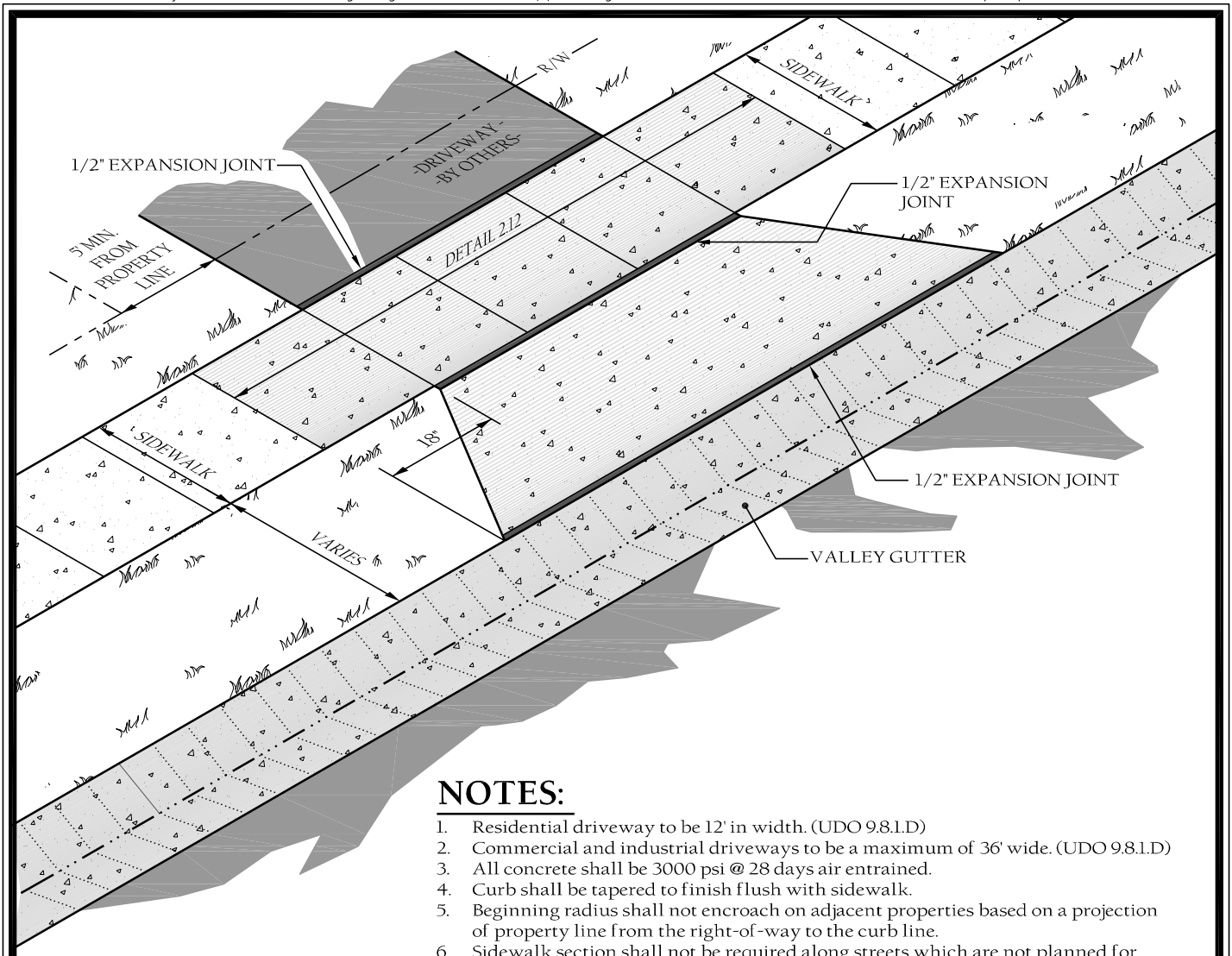

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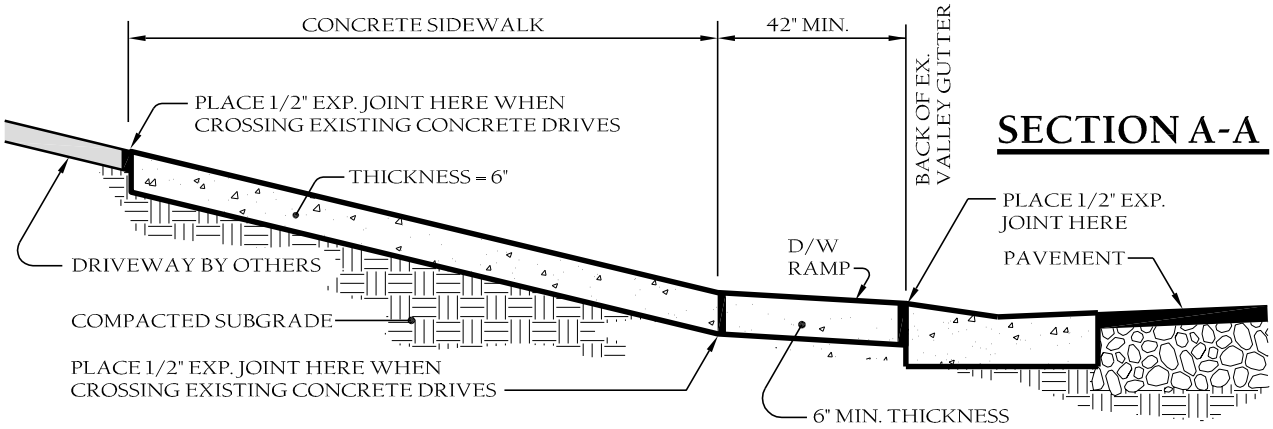

TOWN of WAKE FOREST

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FLARED DRIVEWAY ENTRANCE TO VALLEY GUTTER

Scale:	Detail #:
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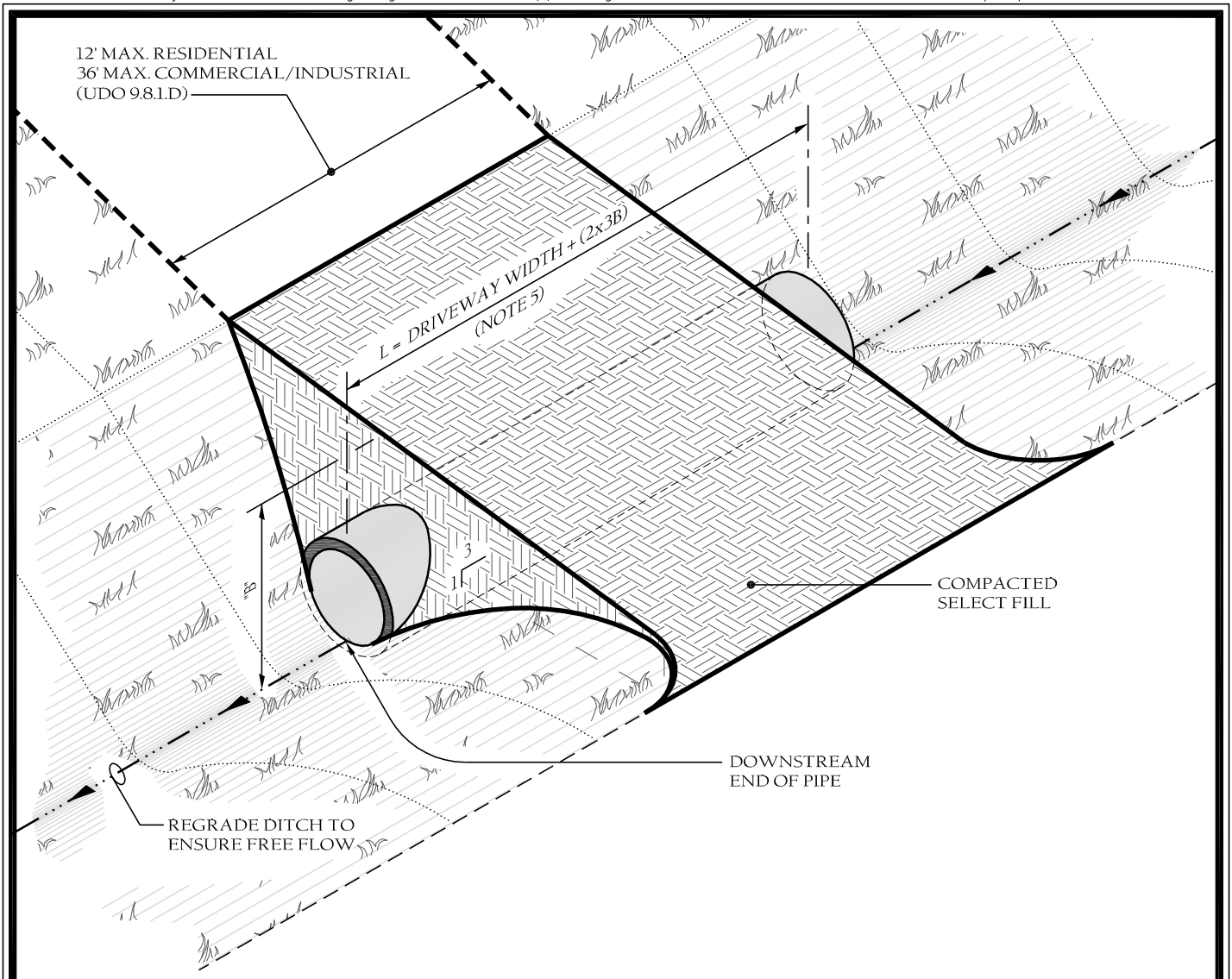

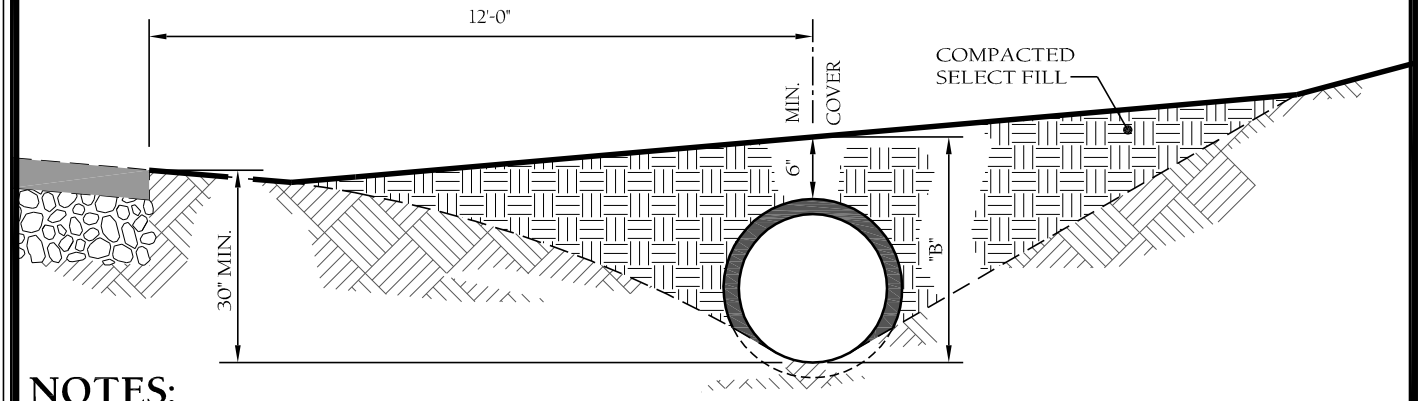

NOTES:

1. D/w pipe 18" and above to have flared end sections.
2. Minimum diameter pipe to be 15" class III "C" wall.
3. D/W pipe to be staked by N.C. licensed surveyor.
4. Driveway pipe shall be concrete pipe only.
5. "L" to be rounded up to next 4' increment.
6. Decorative headwalls may be allowed at discretion of Town's Engineer. An encroachment agreement will be required.

TOWN of WAKE FOREST

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INSTALLATION OF D/W PIPE IN STREET SECTION

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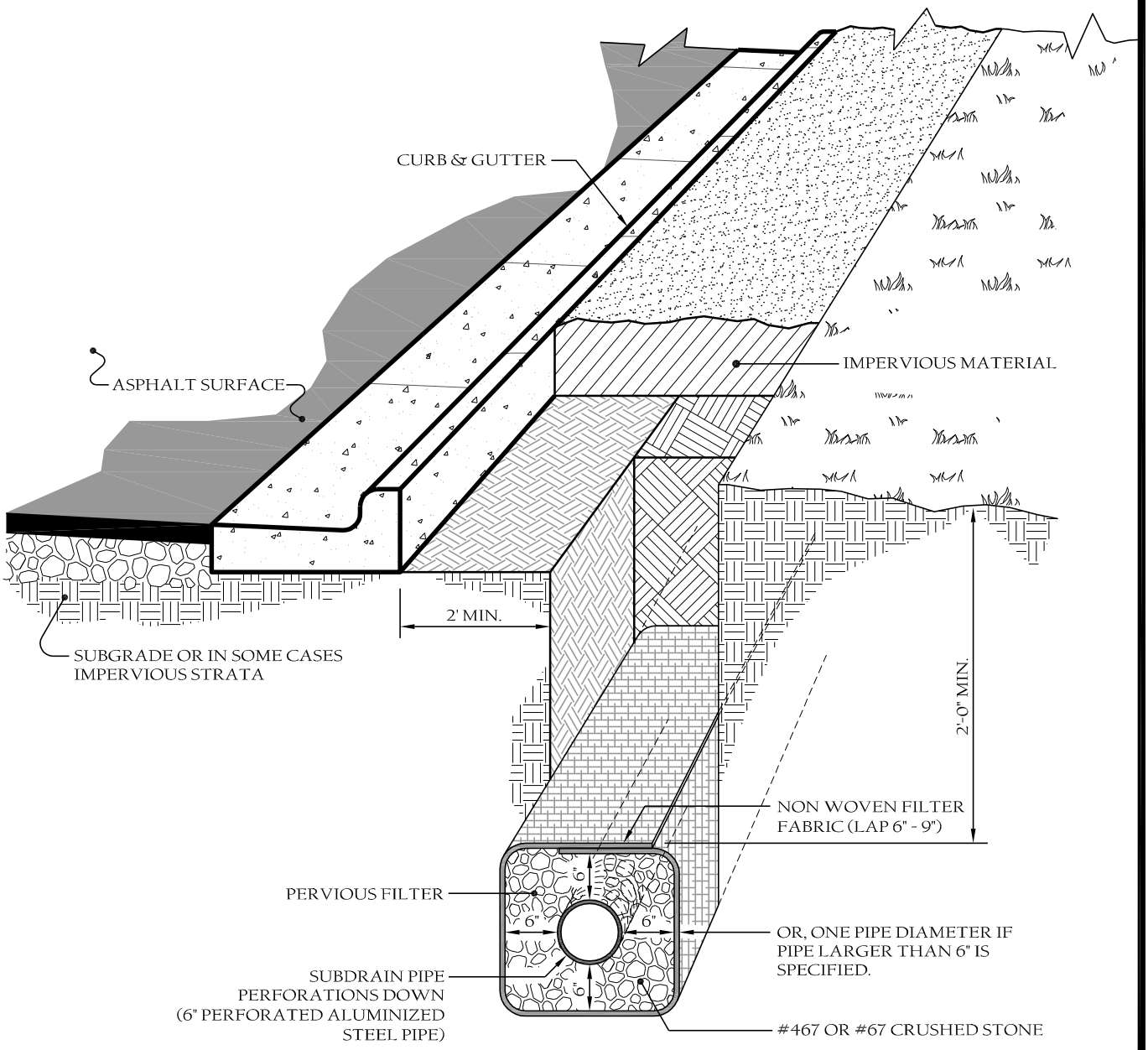

NOTES:

1. Subdrains shall tie or empty into catch basin only. No ties or connections will be allowed on a pipe culvert of any kind.

TOWN of WAKE FOREST

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STANDARD SUBDRAIN BEHIND CURB & GUTTER

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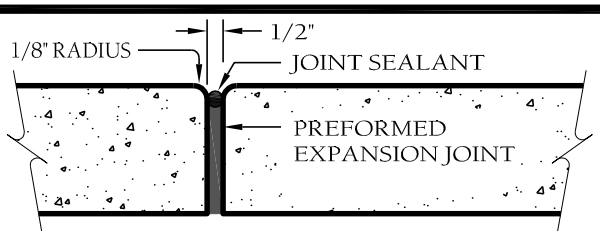
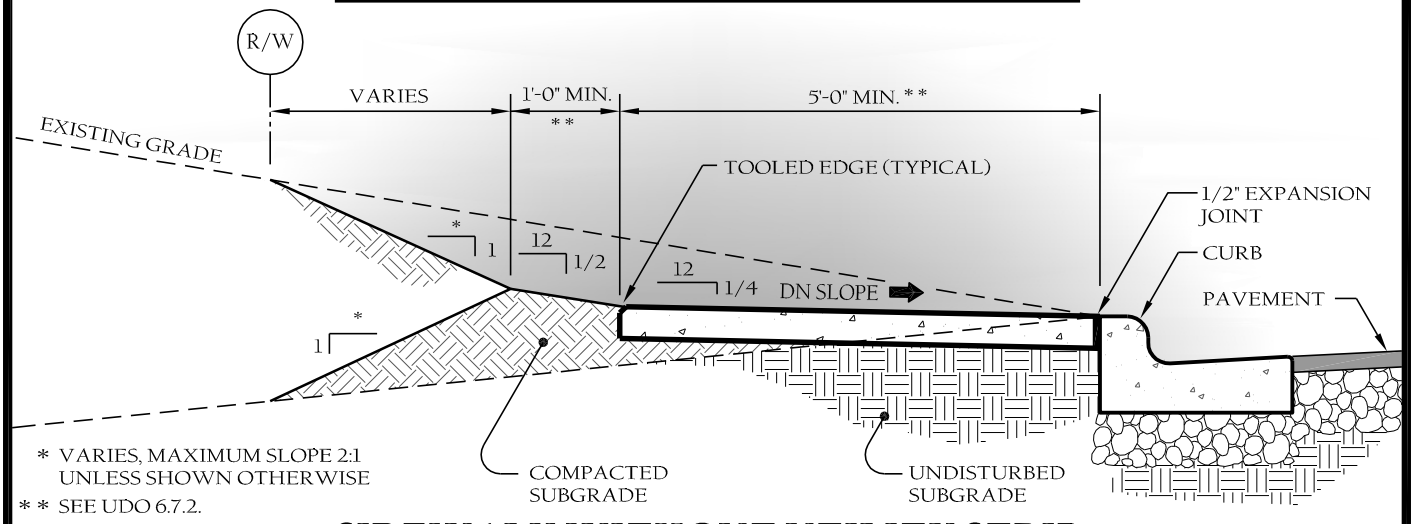
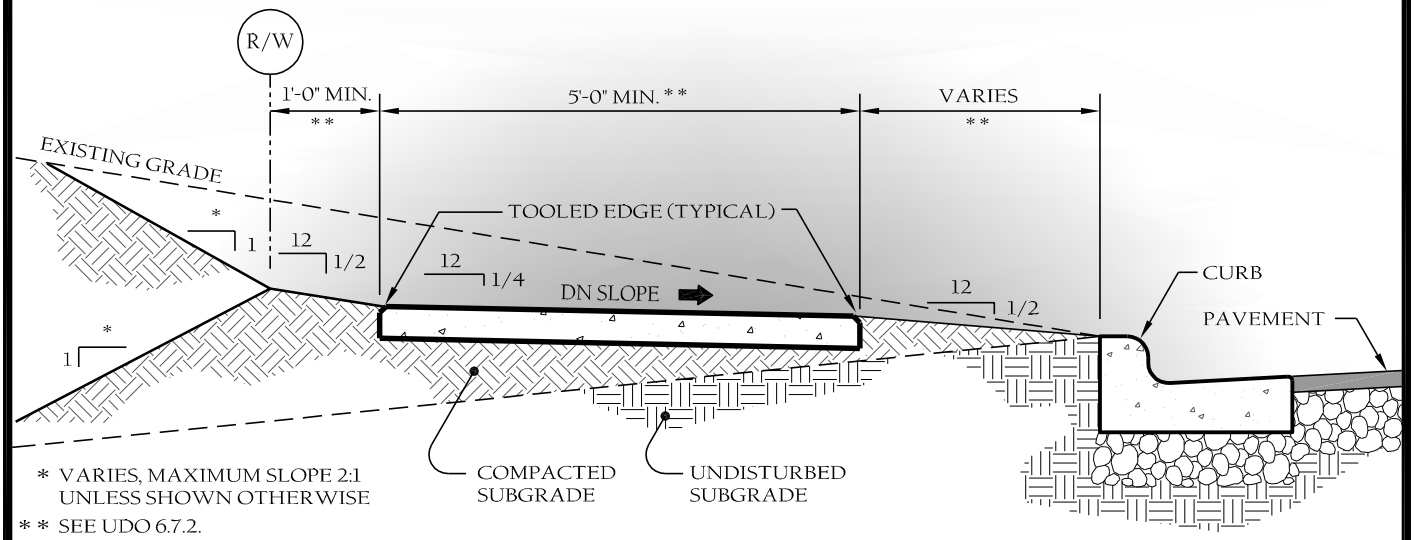


TYPICAL EXPANSION JOINT DETAIL



SIDEWALK WITHOUT UTILITY STRIP



SIDEWALK WITH UTILITY STRIP

NOTES:

1. Provide 3/4" deep tooled score at 5'-0" O.C.
2. Expansion joints to be placed 30'-0" O.C. longitudinally, adjacent to curbs, and when butting existing structures, concrete, or buildings.
3. Concrete to be 3,000 P.S.I. at 28 days, air-entrained.
4. Subgrade should not contain organic matter or plastic clays. When found, refer to specs or contact engineer for directions.
5. Areas of fill are to be compacted to 95% standard proctor using NCDOT Class III borrow or better. Remove topsoil before placing borrow.
8. Concrete must come from a ready mix concrete truck to ensure mix meets air entrainment requirements. No site mix or sakrete mix allowed.
9. See Specification 02400, paragraph 2.1.3 & 2.1.4 for expansion joint & joint sealer specs.

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TYP SIDEWALK in CUT or FILL SECTIONS

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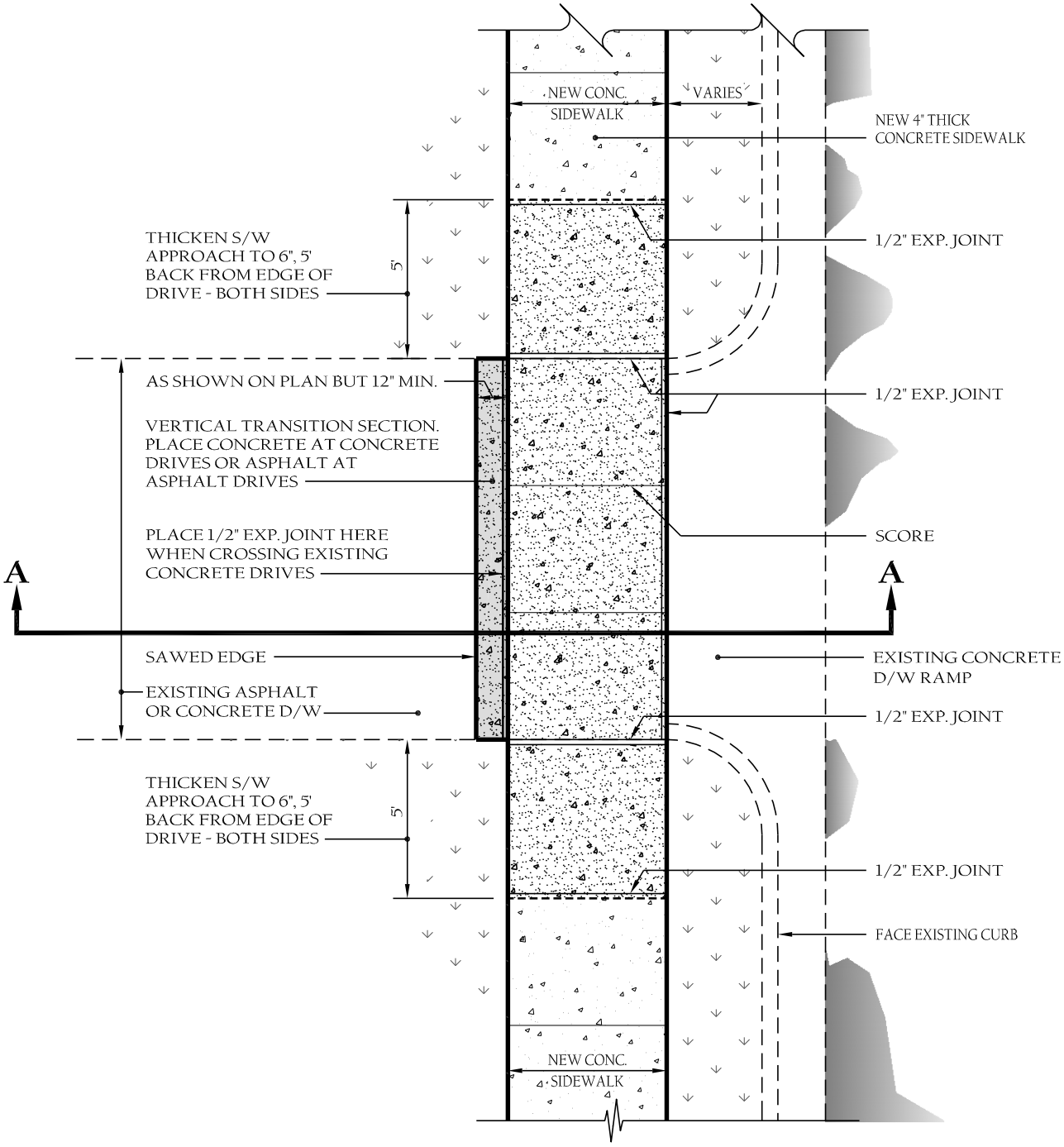

NOTES:

1. Concrete must come from a ready mix concrete truck to ensure mix meets air entrainment requirements. No site mix or sakrete mix allowed.

TOWN of WAKE FOREST

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SIDEWALK DETAIL X-ING EX. DRIVEWAYS

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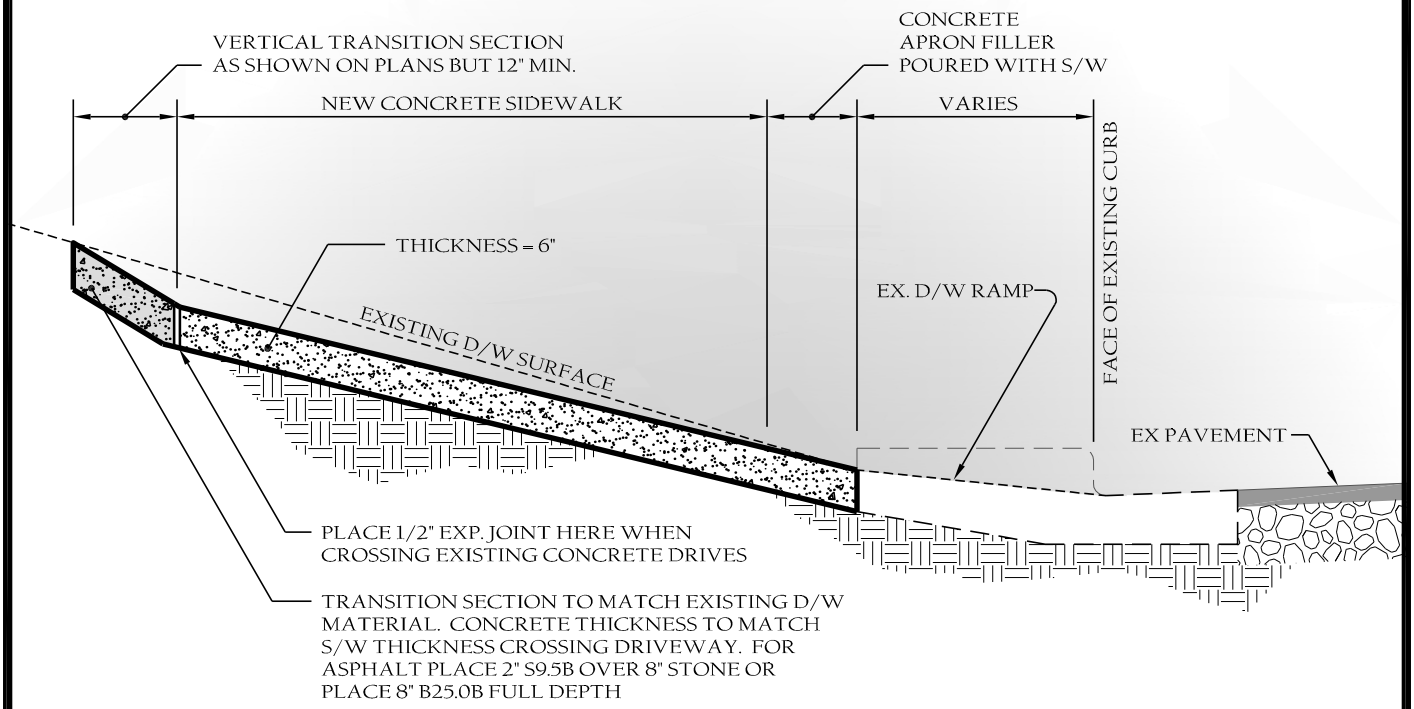

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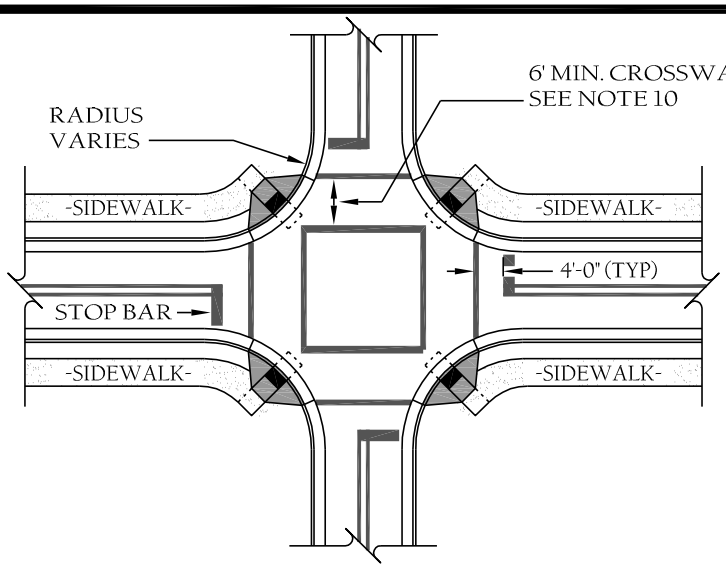
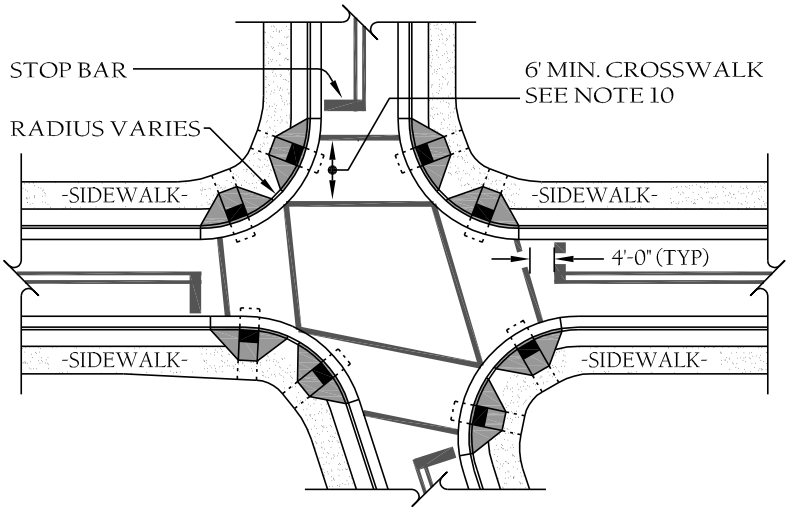
	SIDEWALK DETAIL X-ING EX. DRIVEWAYS	Scale: Not To Scale	Detail #: 9.12
		Revision Date: Feb., 2015	Sheet #: 2 of 2



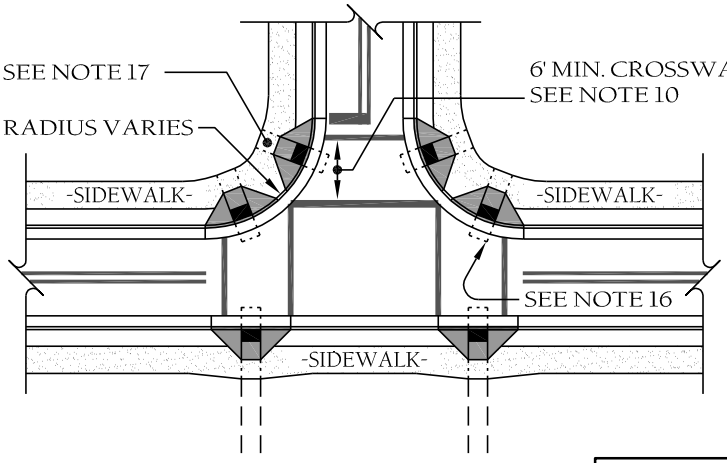
FOR CROSSING INTERSECTIONS

DETAIL SHOWING TYPICAL LOCATION OF SINGLE CURB RAMPS, PEDESTRIAN CROSSWALKS AND STOP LINES FOR TEE INTERSECTIONS



FOR CROSSING INTERSECTIONS

DETAIL SHOWING TYPICAL LOCATION OF DUAL CURB RAMPS, PEDESTRIAN CROSSWALKS AND STOP LINES FOR TEE INTERSECTIONS



FOR TEE INTERSECTIONS

DETAIL SHOWING TYPICAL LOCATION OF CURB RAMPS, PEDESTRIAN CROSSWALKS AND STOP LINES FOR TEE INTERSECTIONS

PROPOSED CURB RAMP

-SIDEWALK- *PROPOSED OR FUTURE SIDEWALK*

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STANDARD CURB RAMP PLACEMENT DETAIL

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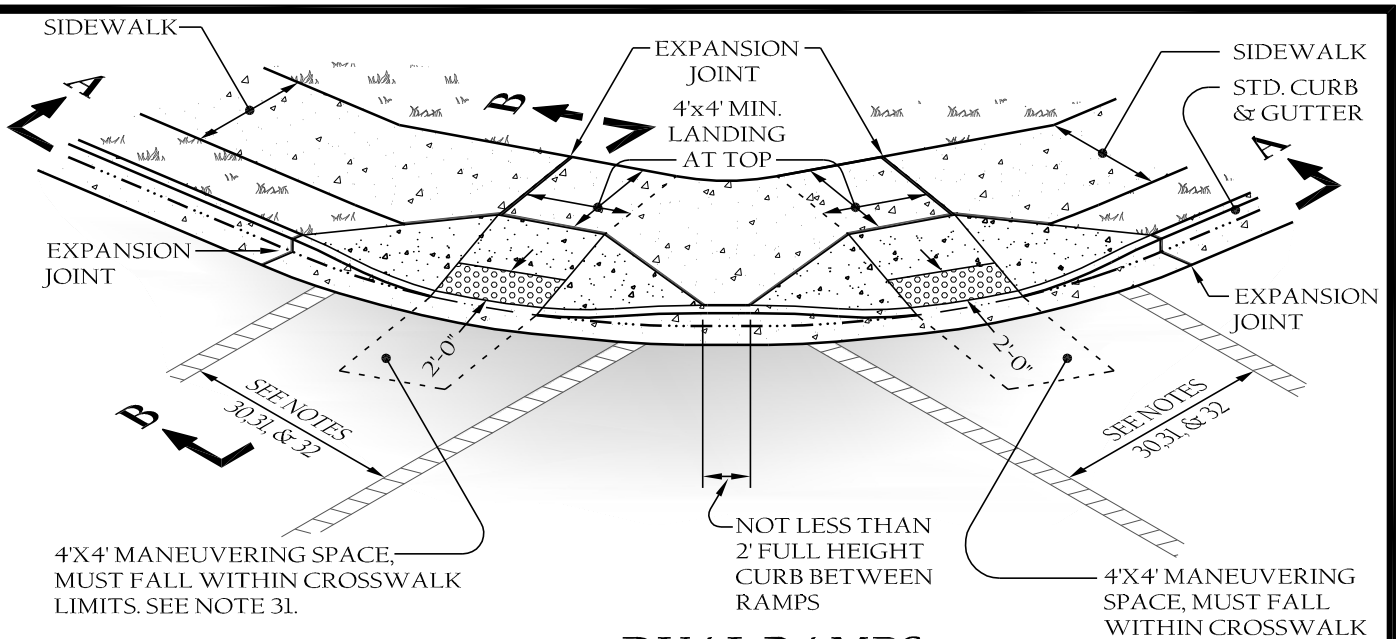
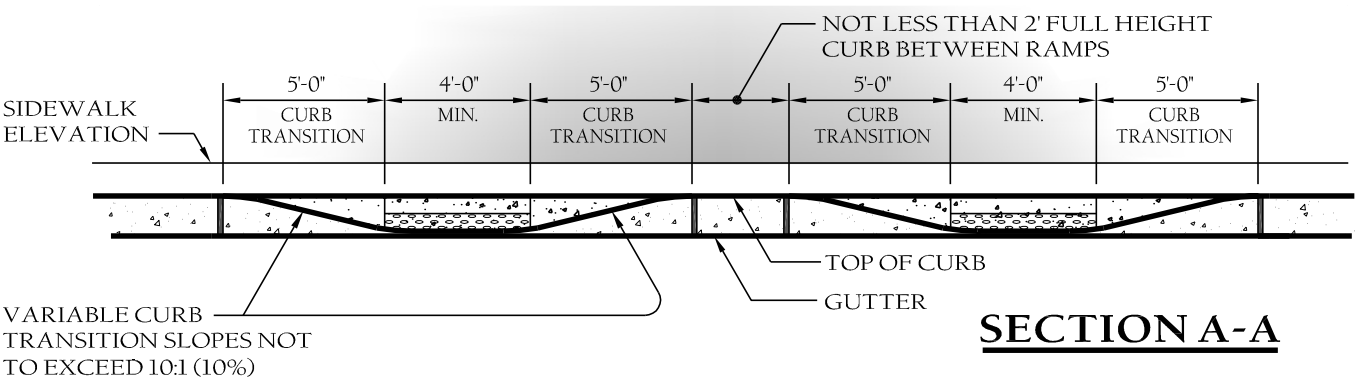


DUAL RAMPS

ANY RADII

NOTE: A PORTION OF ONE OR BOTH RAMPS MAY EXTEND OUTSIDE THE RETURNS



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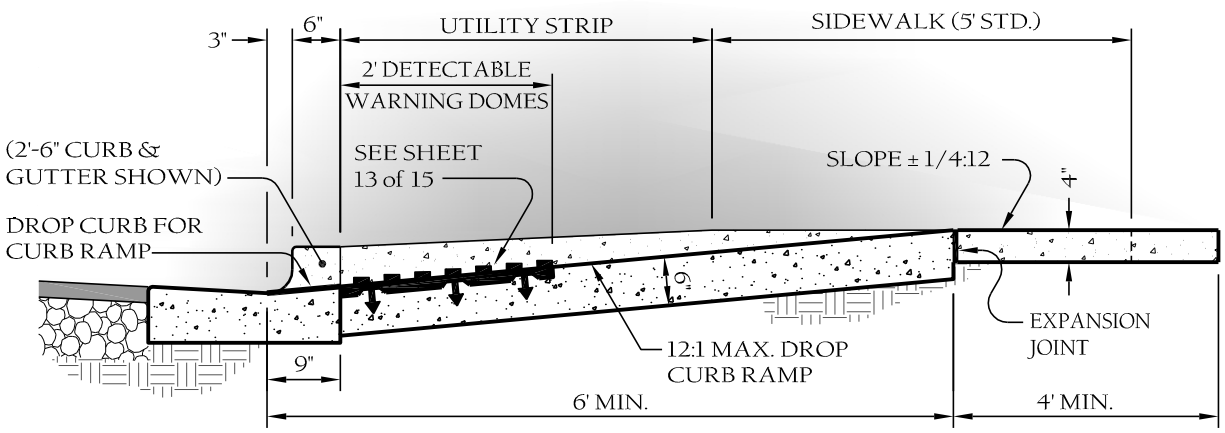

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TOWN of WAKE FOREST

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STANDARD CURB RAMP DETAILS

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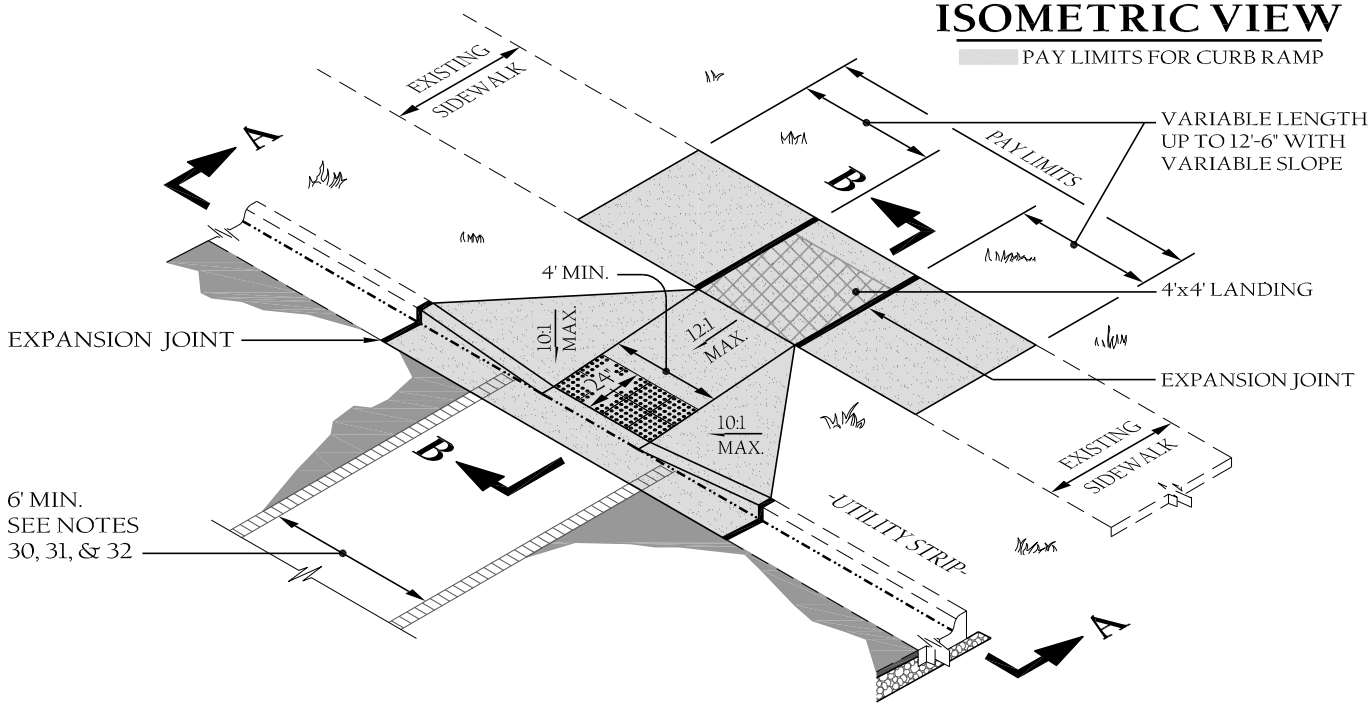
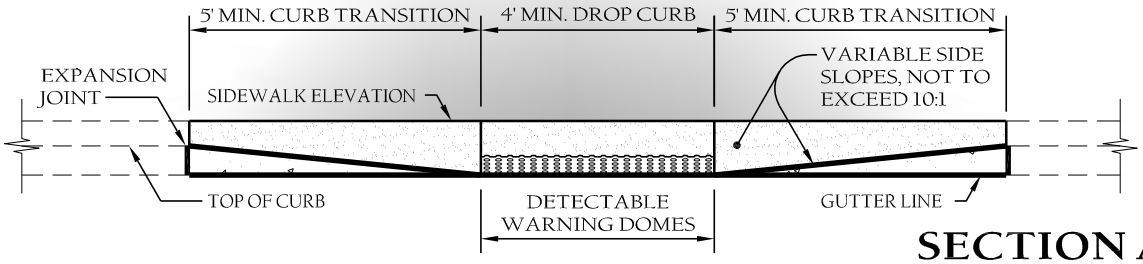
ISOMETRIC VIEW





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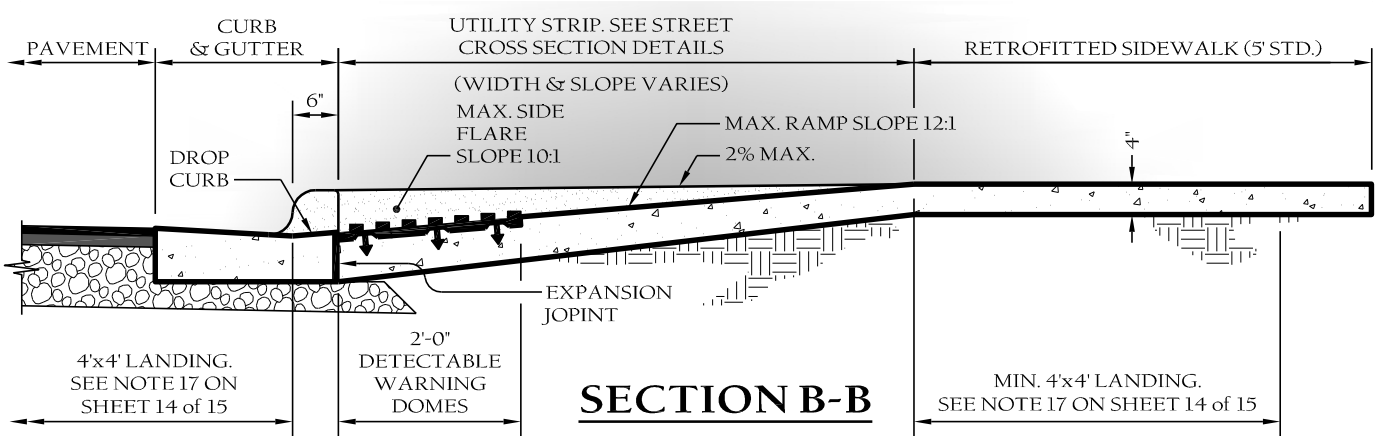

SECTION B-B

NOTES:

1. Detectable warning domes will cover 2'-0" length and full width of the ramp floor as shown on sheet 13 of 15.

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SINGLE CURB RAMP WITH EXISTING CURB & GUTTER

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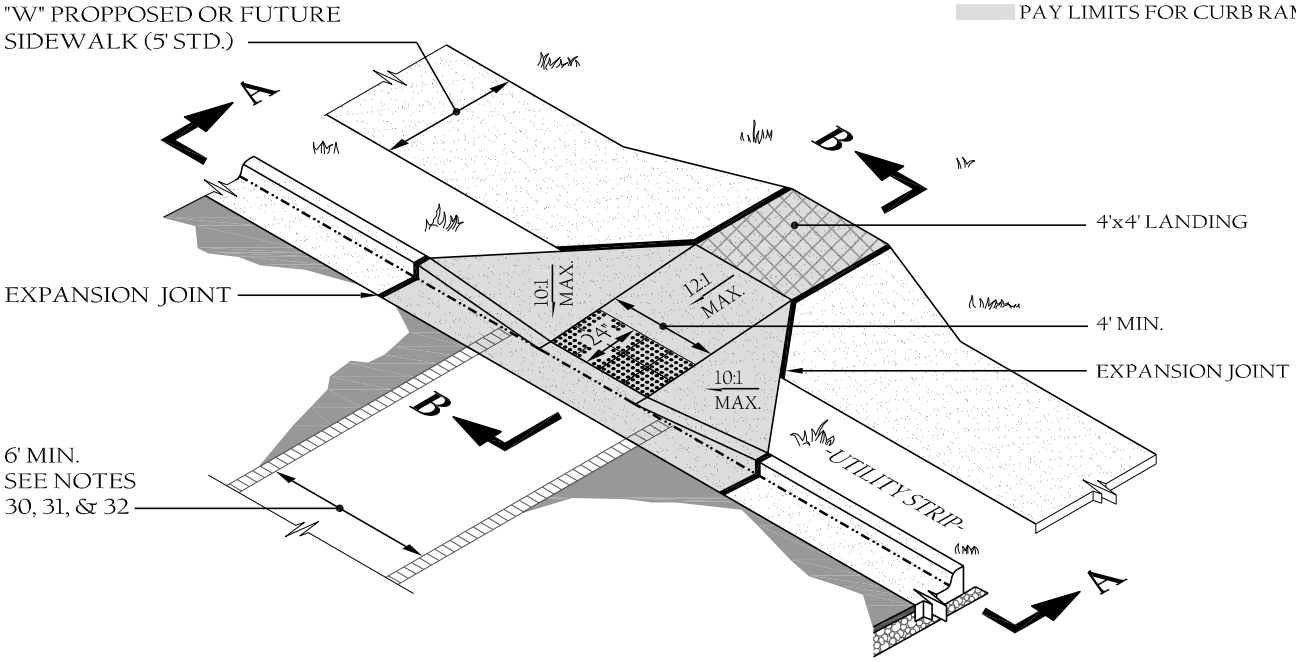
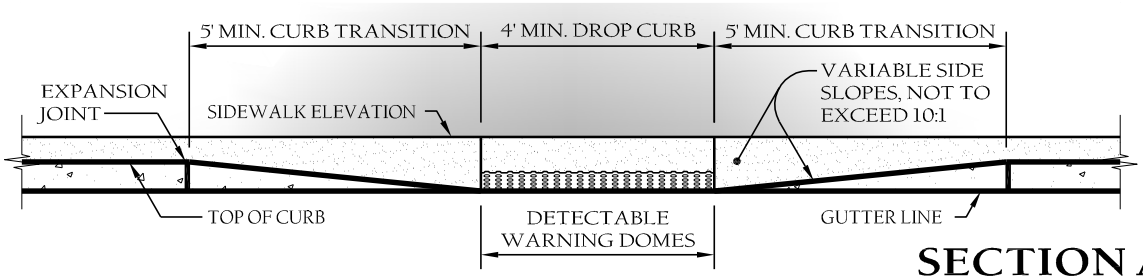
ISOMETRIC VIEW

PAY LIMITS FOR CURB RAMP





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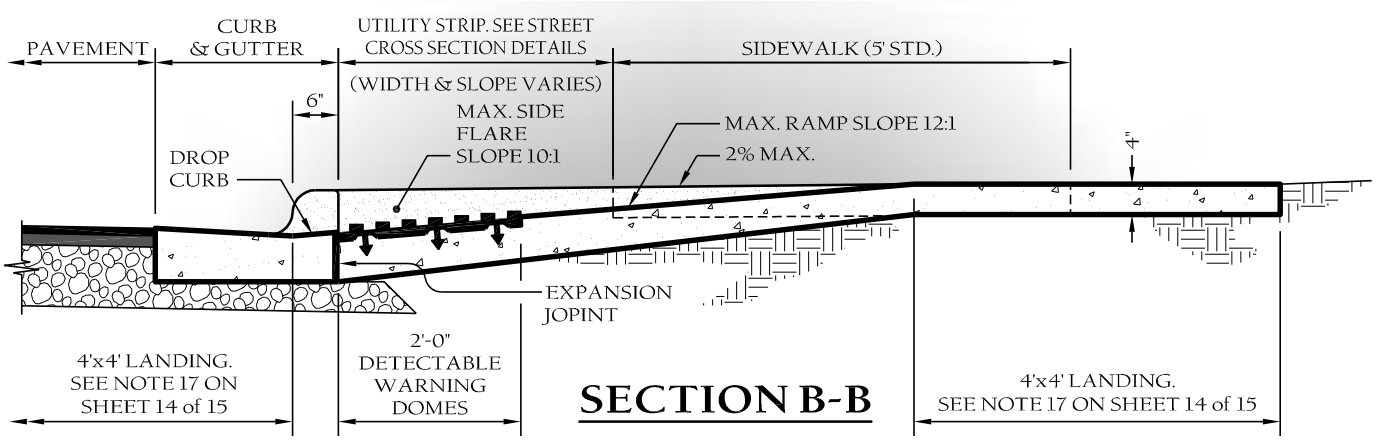

SECTION B-B

NOTES:

1. Detectable warning domes will cover 2'-0" length and full width of the ramp floor as shown on sheet 13 of 15.

TOWN of WAKE FOREST

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SINGLE CURB RAMP WITH PROPOSED CURB & GUTTER

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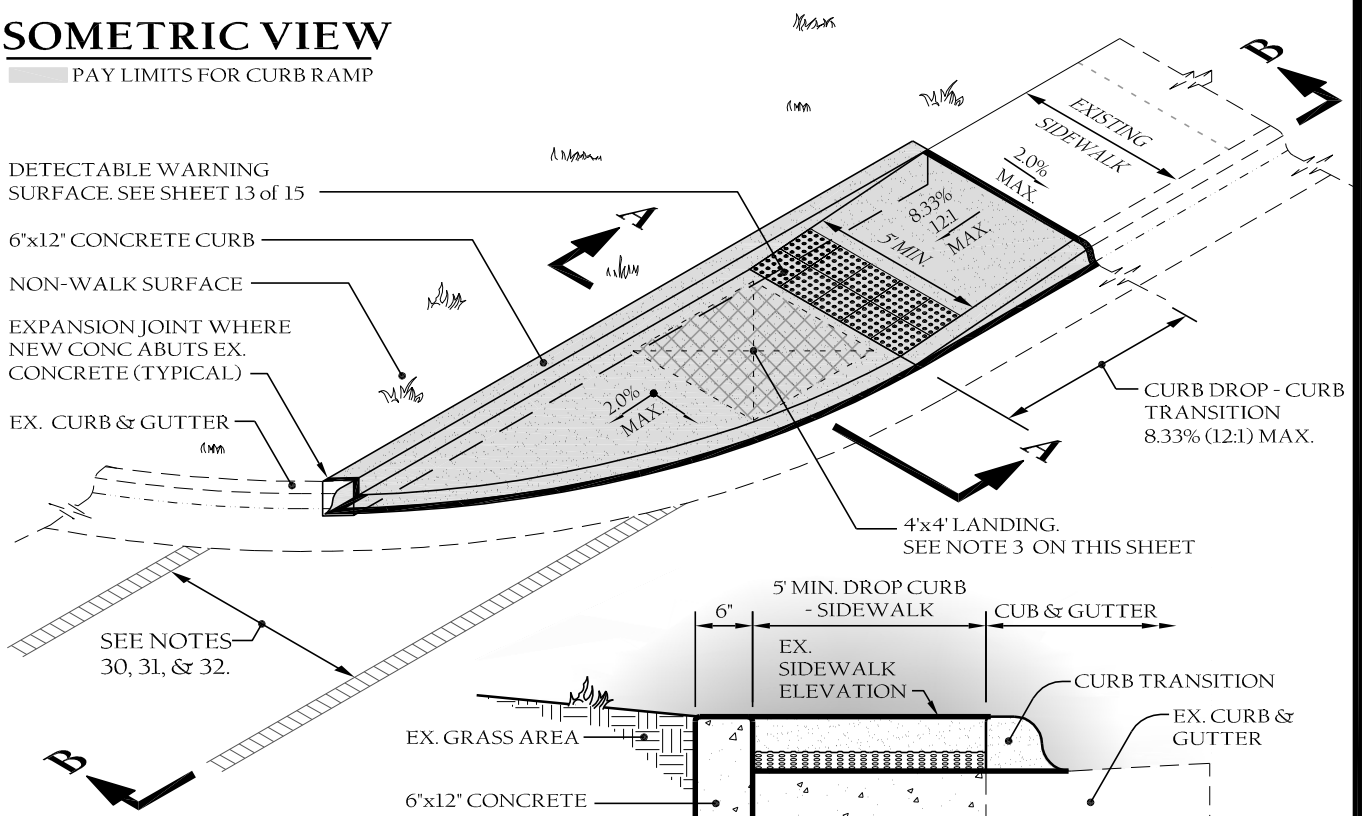
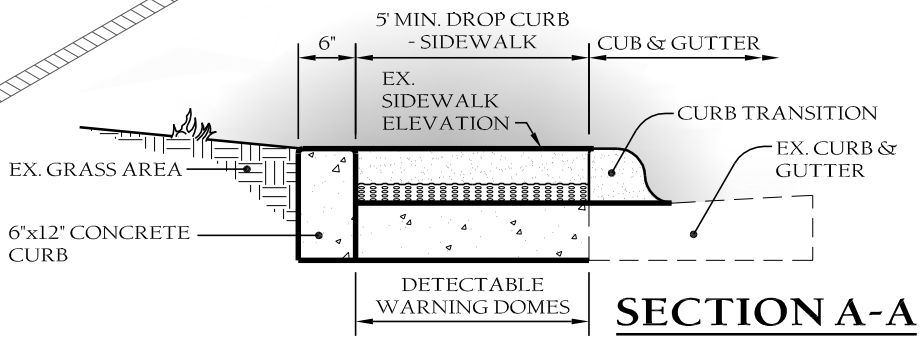
ISOMETRIC VIEW

PAY LIMITS FOR CURB RAMP





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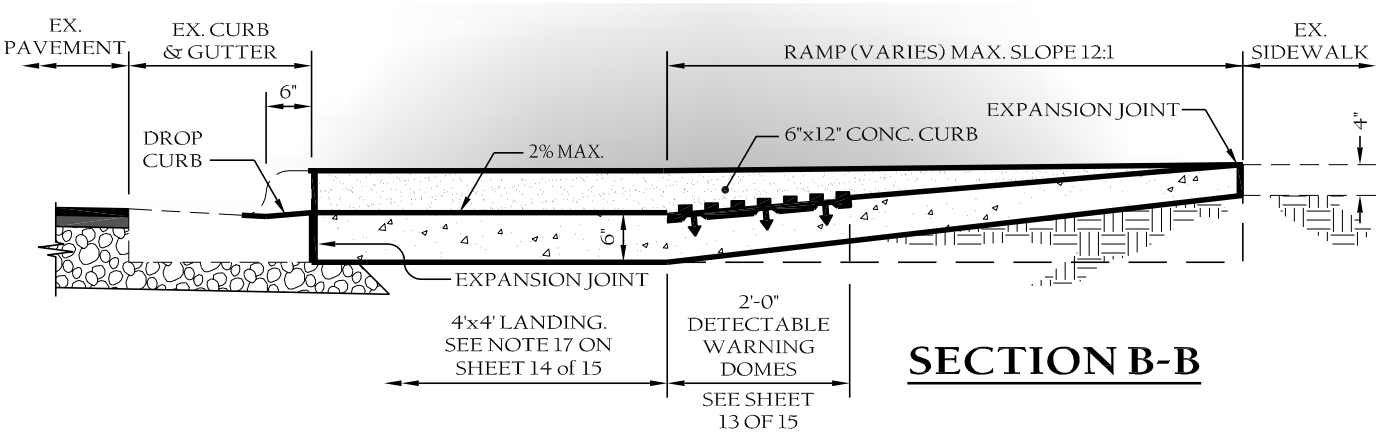

SECTION B-B

NOTES:

1. Maximum curb ramp slope 8.33% (12:1)
2. Maximum cross slope 2.00%
3. Curb ramps require a (4'-0") minimum landing with a maximum cross slope and longitudinal slope of 2.00% where pedestrians perform turning maneuvers. Slope to drain to curb.
4. Detectable warning domes will cover 2'-0" length and full width of the ramp floor as shown on sheet 13 of 15.
5. Refer to sheet 14 & 15 of 15 for all ramp notes. Adopted from NCDOT Alternate Curb Ramp Details.

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CURB RAMPS - DIRECTIONAL TYPE 1

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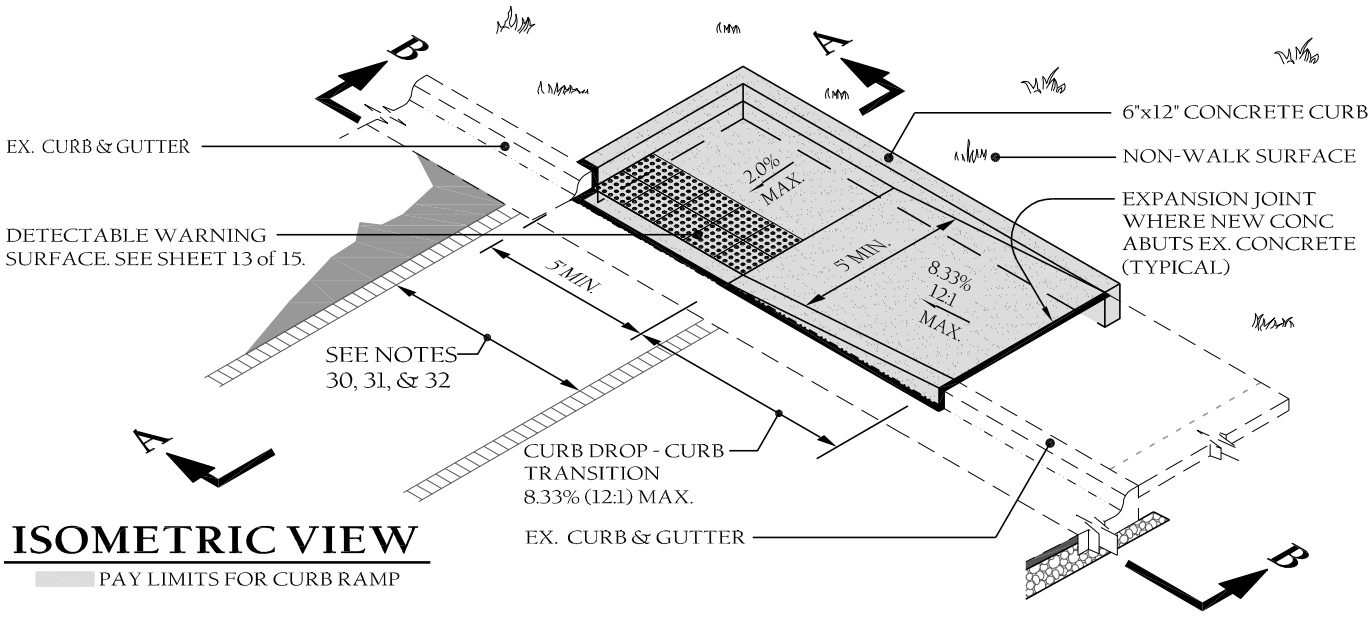
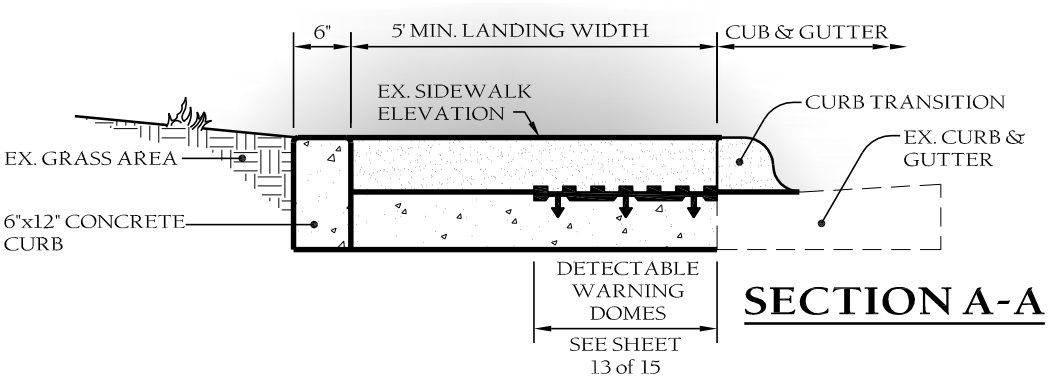
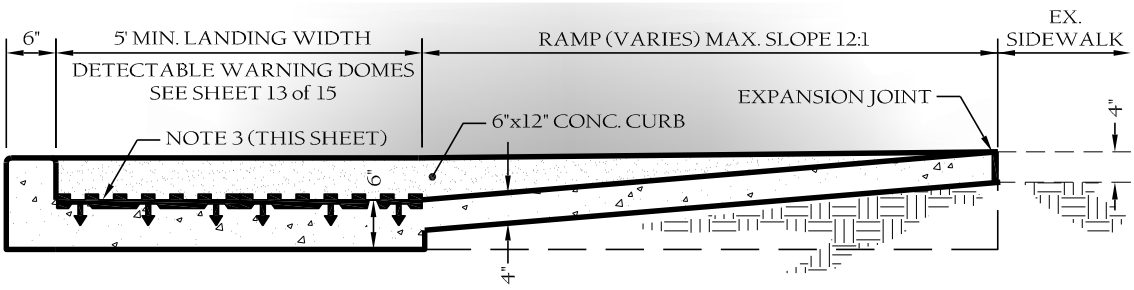


ISOMETRIC VIEW

PAY LIMITS FOR CURB RAMP



SECTION A-A



SECTION B-B

NOTES:

1. Maximum curb ramp slope 8.33% (12:1)
2. Maximum cross slope 2.00%
3. Curb ramps require a (4'-0") minimum landing with a maximum cross slope and longitudinal slope of 2.00% where pedestrians perform turning maneuvers. Slope to drain to curb.
4. Detectable warning domes will cover 2'-0" length and full width of the ramp floor as shown on sheet 13 of 15.
5. Refer to sheet 14 & 15 of 15 for all ramp notes. Adopted from NCDOT Alternate Curb Ramp Details.

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CURB RAMPS - DIRECTIONAL TYPE 1A

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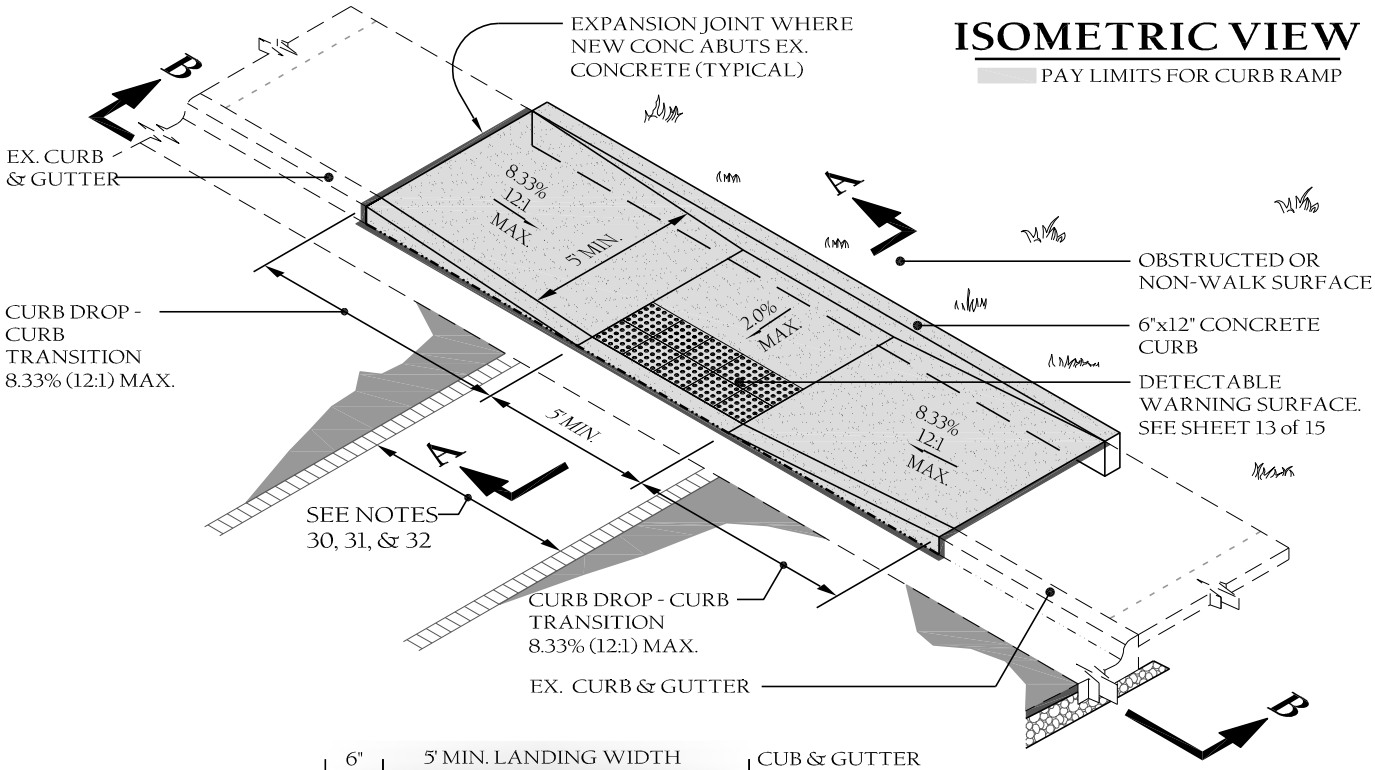
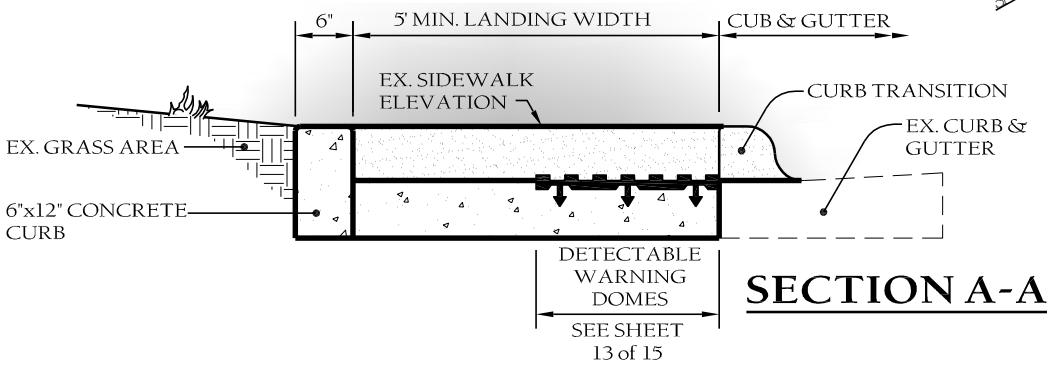
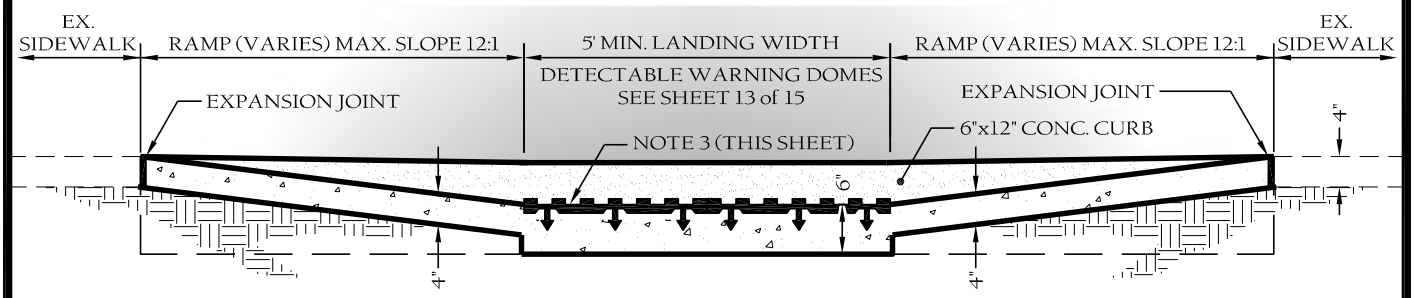




SECTION A-A



SECTION B-B

NOTES:

1. Maximum curb ramp slope 8.33% (12:1)
2. Maximum cross slope 2.00%
3. Curb ramps require a (4'-0") minimum landing with a maximum cross slope and longitudinal slope of 2.00% where pedestrians perform turning maneuvers. Slope to drain to curb.
4. Detectable warning domes will cover 2'-0" length and full width of the ramp floor as shown on sheet 13 of 15.
5. Refer to sheet 14 & 15 of 15 for all ramp notes. Adopted from NCDOT Alternate Curb Ramp Details.

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CURB RAMPS - DIRECTIONAL TYPE 2

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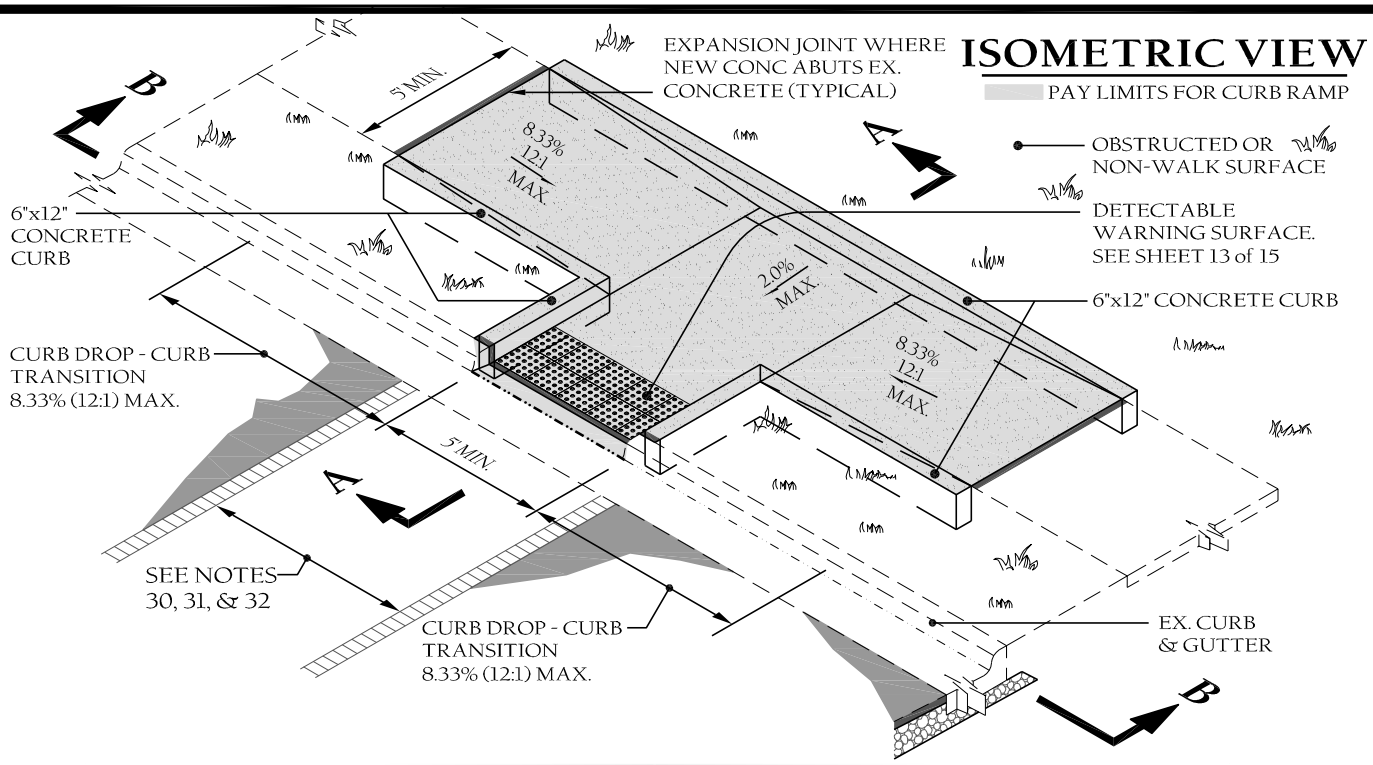
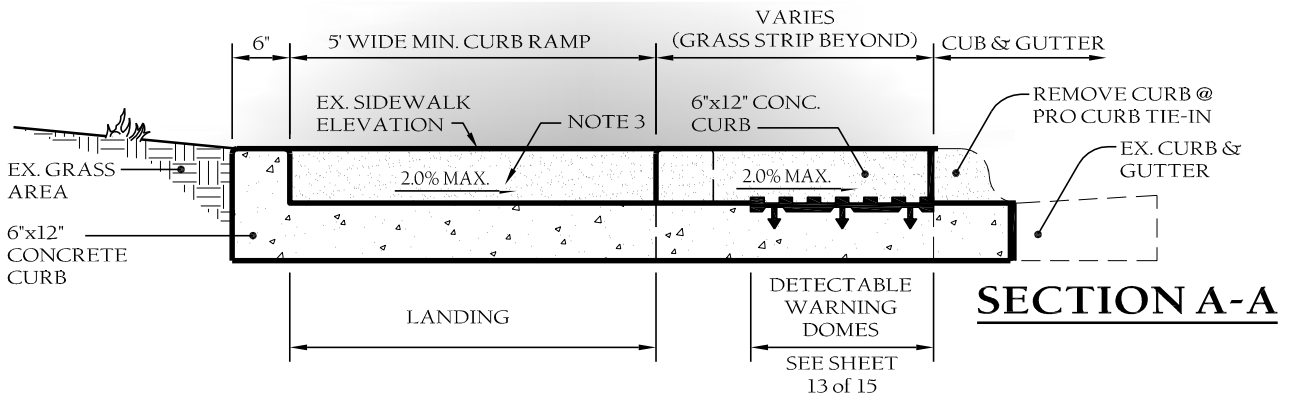
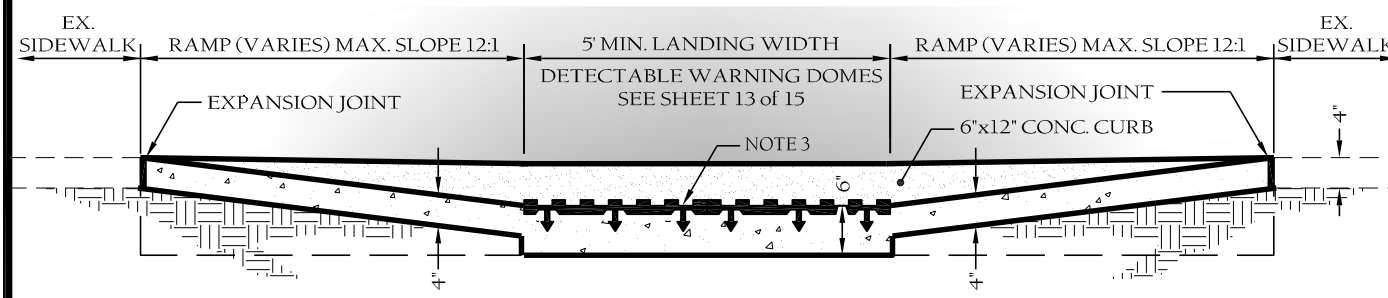




SECTION A-A



SECTION B-B

NOTES:

1. Maximum curb ramp slope 8.33% (12:1)
2. Maximum cross slope 2.00%
3. Curb ramps require a (4'-0") minimum landing with a maximum cross slope and longitudinal slope of 2.00% where pedestrians perform turning maneuvers. Slope to drain to curb.
4. Detectable warning domes will cover 2'-0" length and full width of the ramp floor as shown on sheet 13 of 15.
5. Refer to sheet 14 & 15 of 15 for all ramp notes. Adopted from NCDOT Alternate Curb Ramp Details.

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CURB RAMPS - DIRECTIONAL TYPE 3

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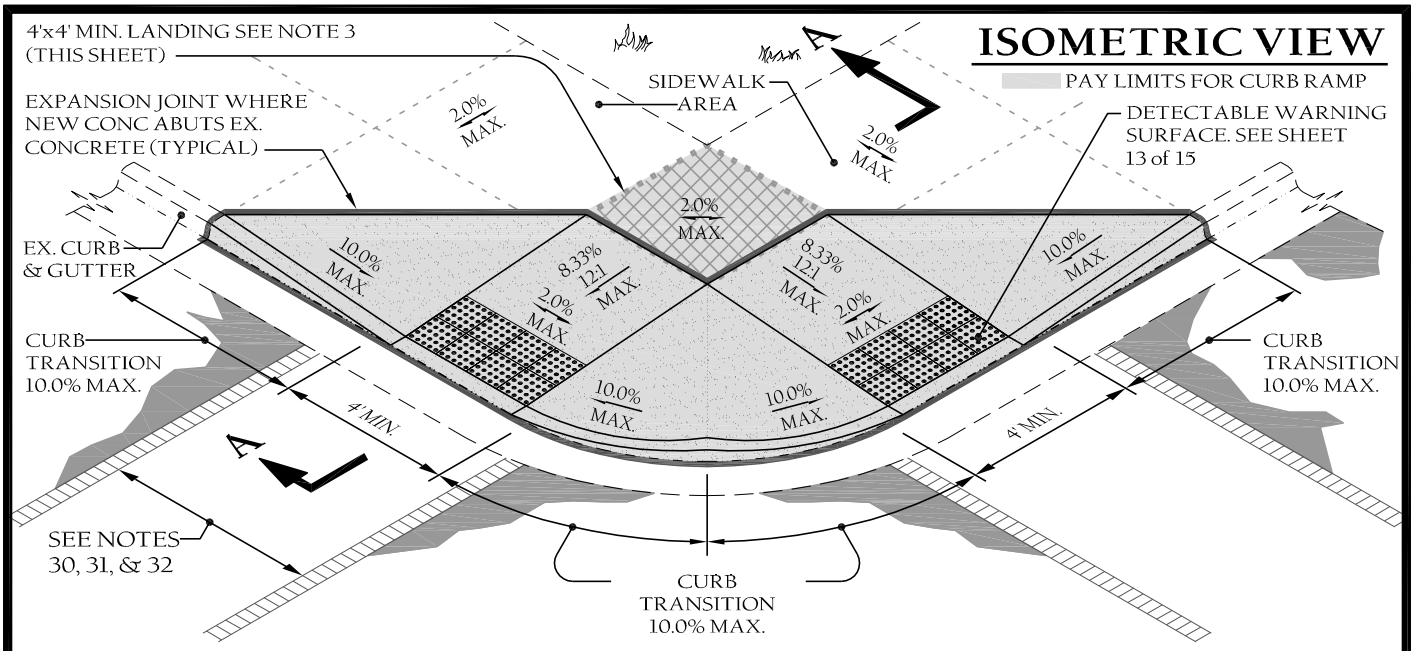
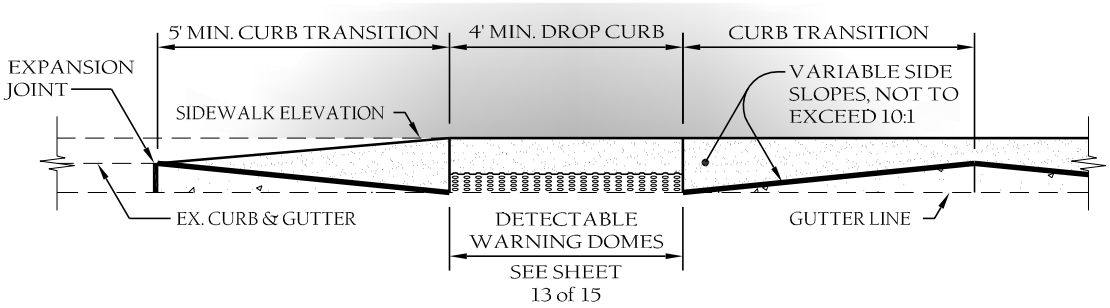
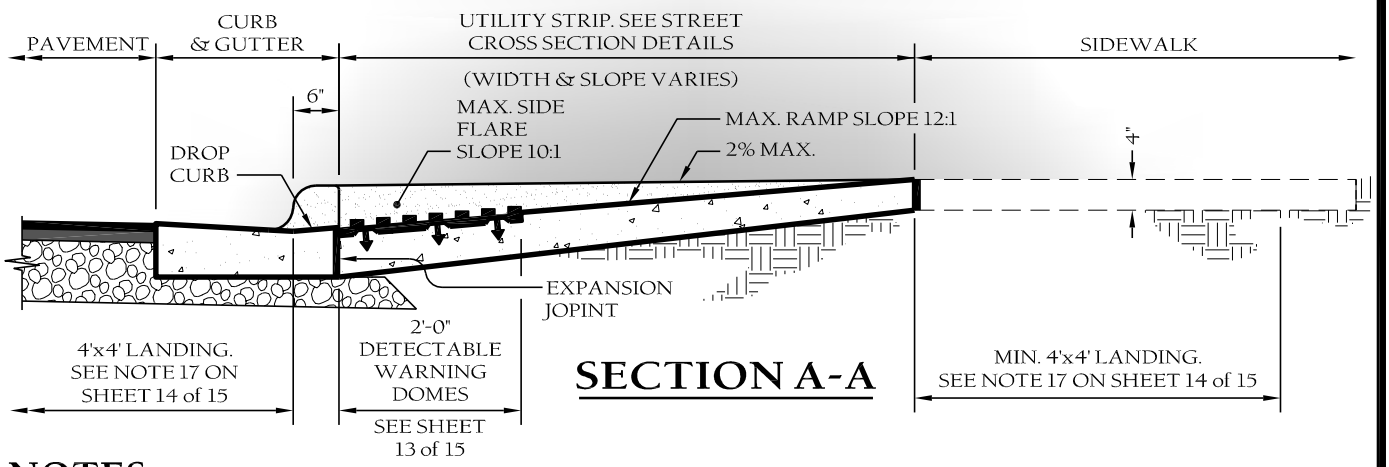
ISOMETRIC VIEW





PARTIAL CURB ELEVATION



SECTION A-A

NOTES:

1. Maximum curb ramp slope 8.33% (12:1)
2. Maximum cross slope 2.00%
3. Curb ramps require a (4'-0") minimum landing with a maximum cross slope and longitudinal slope of 2.00% where pedestrians perform turning maneuvers. Slope to drain to curb.
4. Detectable warning domes will cover 2'-0" length and full width of the ramp floor as shown on sheet 13 of 15.
5. Refer to sheet 14 & 15 of 15 for all ramp notes. Adopted from NCDOT Alternate Curb Ramp Details.

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CURB RAMPS - SHARED LANDING TYPE 4

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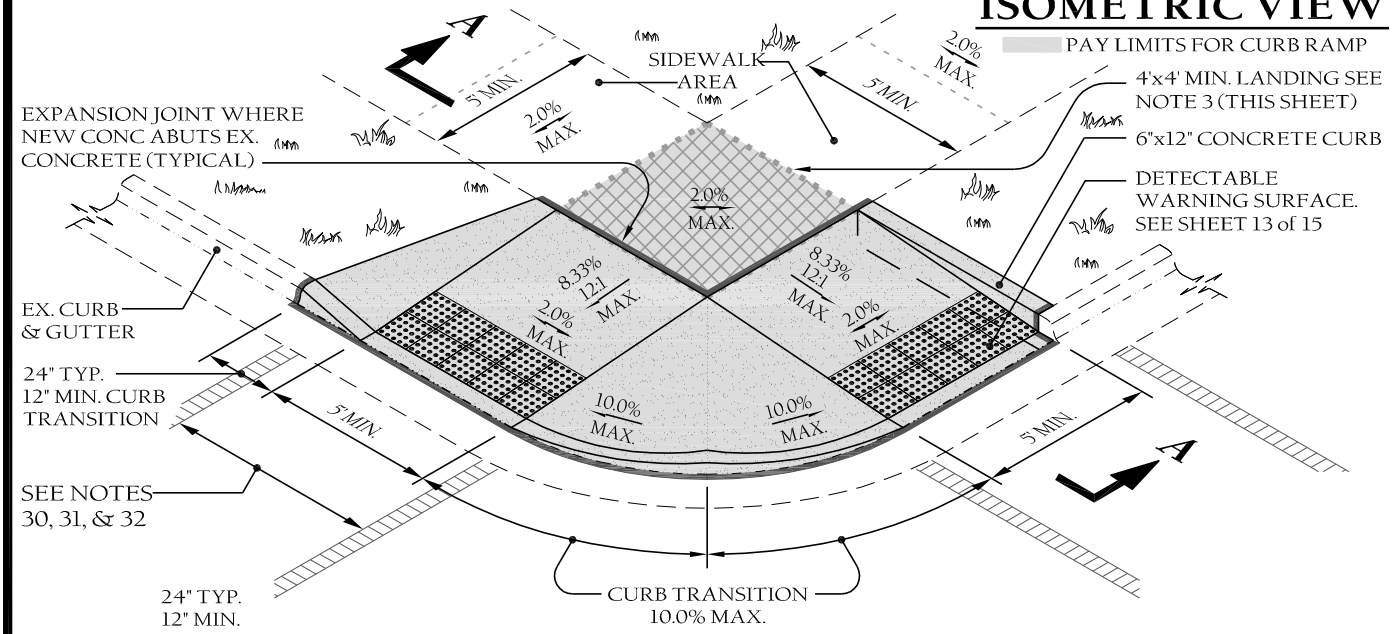
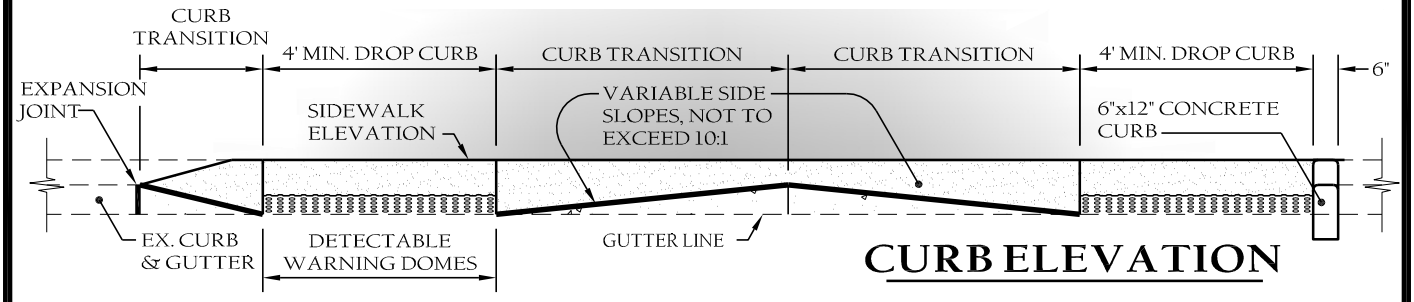
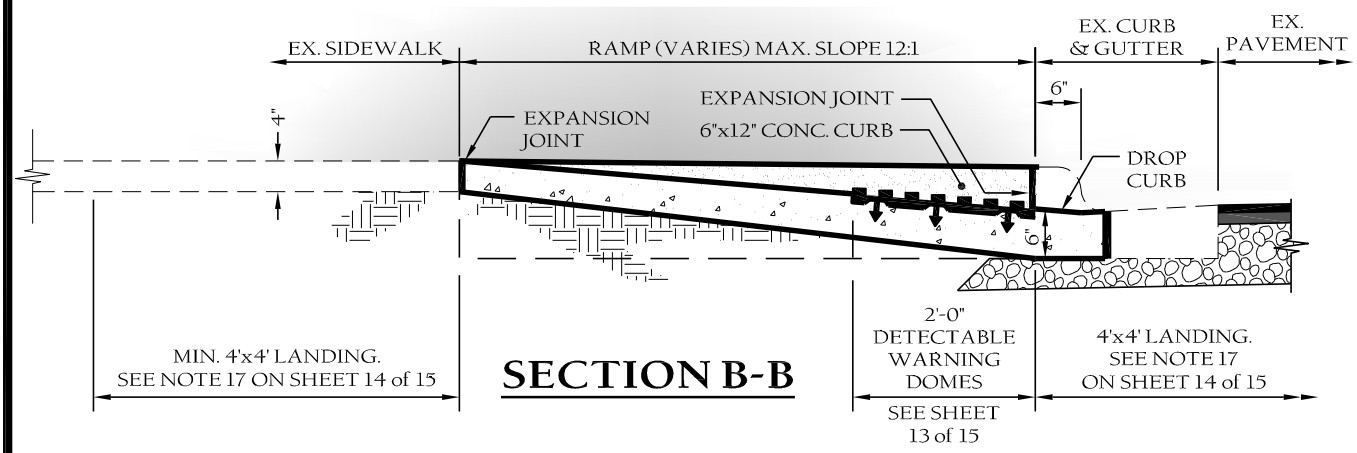
ISOMETRIC VIEW





CURB ELEVATION



SECTION B-B

NOTES:

1. Maximum curb ramp slope 8.33% (12:1)
2. Maximum cross slope 2.00%
3. Curb ramps require a (4'-0") minimum landing with a maximum cross slope and longitudinal slope of 2.00% where pedestrians perform turning maneuvers. Slope to drain to curb.
4. Detectable warning domes will cover 2'-0" length and full width of the ramp floor as shown on sheet 13 of 15.
5. Refer to sheet 14 & 15 of 15 for all ramp notes. Adopted from NCDOT Alternate Curb Ramp Details.

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CURB RAMPS - SHARED LANDING TYPE 4A

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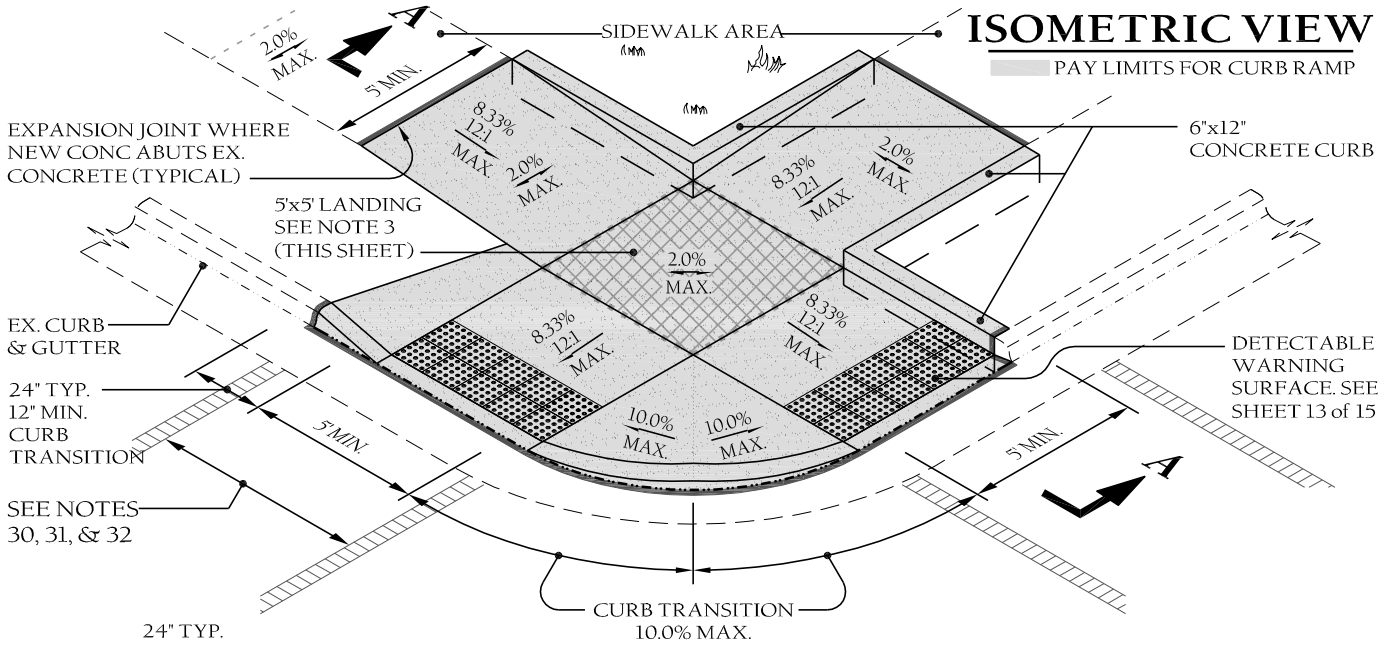
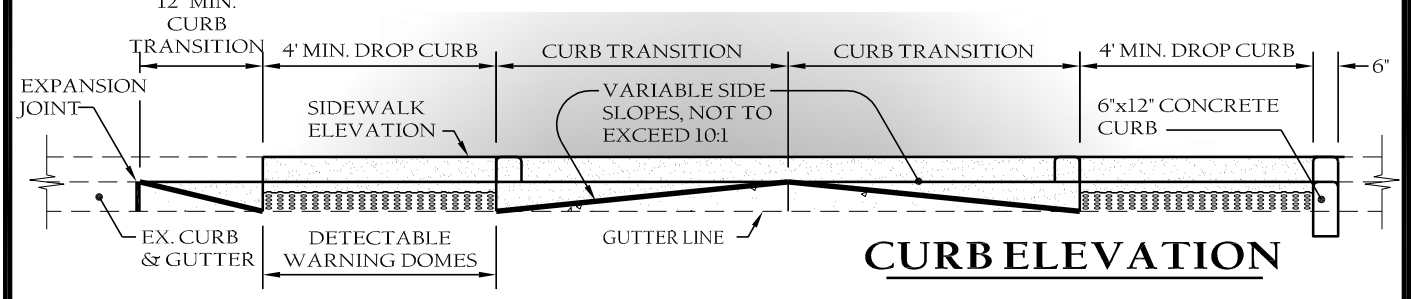
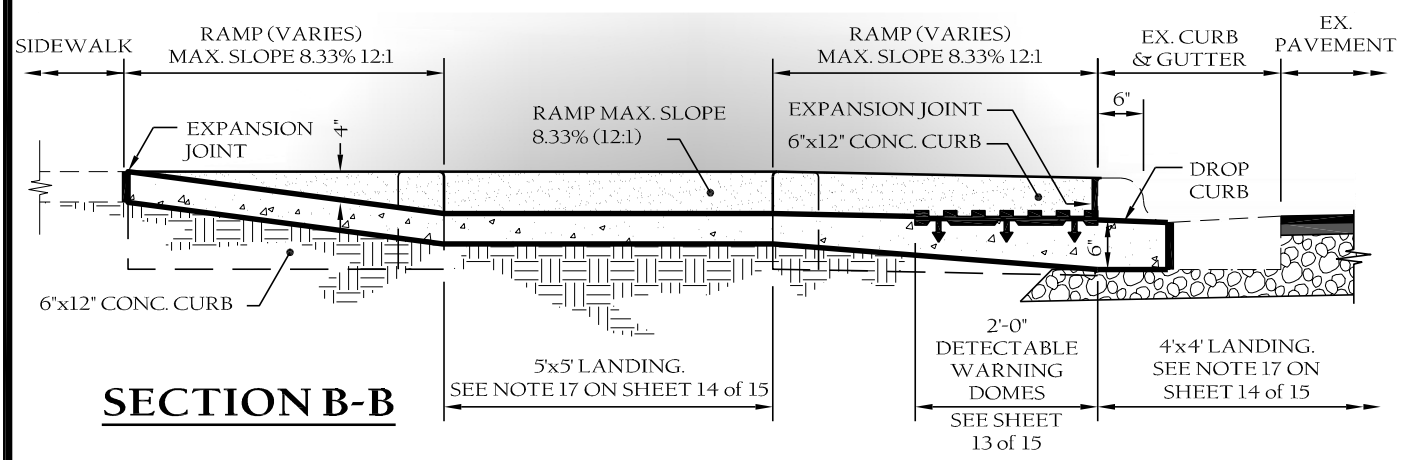




CURB ELEVATION



SECTION B-B

NOTES:

1. Maximum curb ramp slope 8.33% (12:1)
2. Maximum cross slope 2.00%
3. Curb ramps require a (4'-0") minimum landing with a maximum cross slope and longitudinal slope of 2.00% where pedestrians perform turning maneuvers. Slope to drain to curb.
4. Detectable warning domes will cover 2'-0" length and full width of the ramp floor as shown on sheet 13 of 15.
5. Refer to sheet 14 & 15 of 15 for all ramp notes. Adopted from NCDOT Alternate Curb Ramp Details.

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CURB RAMPS - SHARED LANDING TYPE 5

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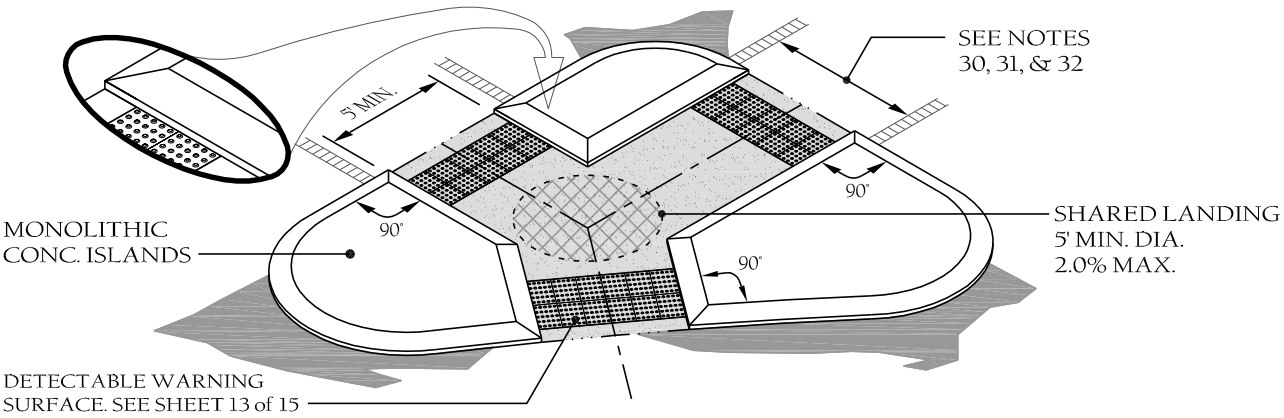
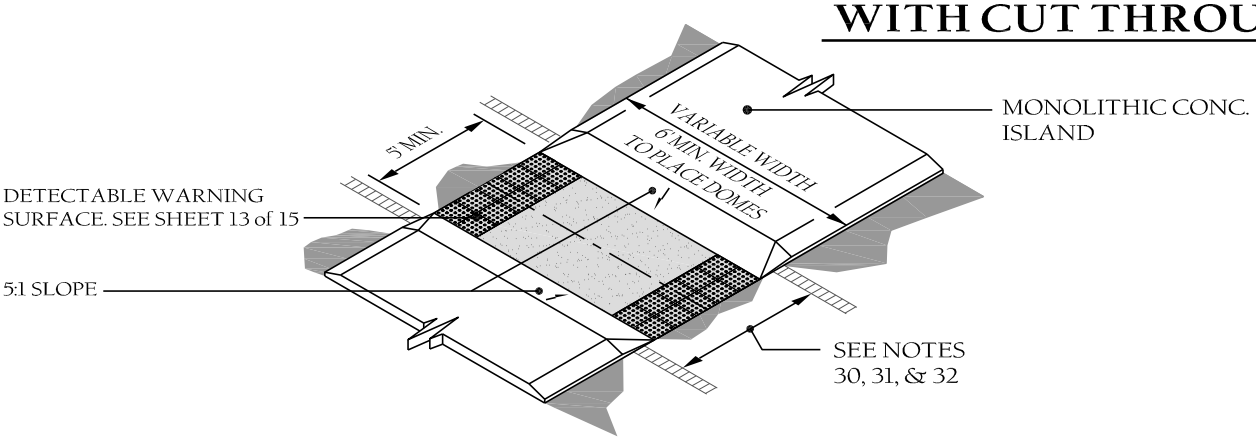
PAY LIMITS FOR CURB RAMP

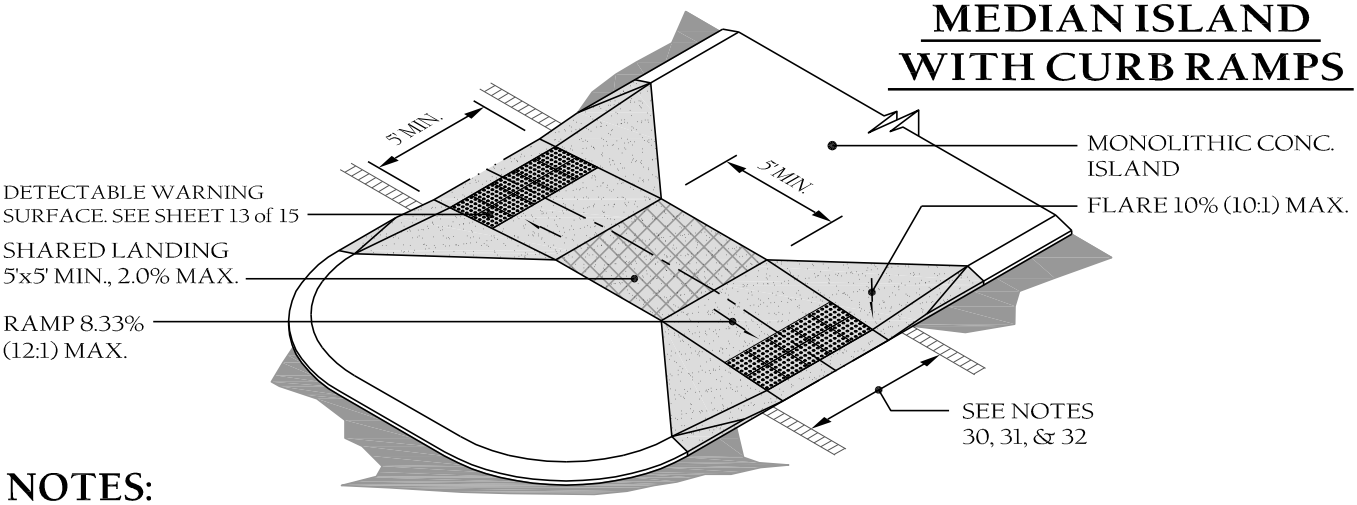
TRIANGULAR ISLAND WITH CUT THROUGH



MEDIAN ISLAND WITH CUT THROUGH



MEDIAN ISLAND WITH CURB RAMPS



NOTES:

1. Maximum curb ramp slope 8.33% (12:1)
2. Maximum cross slope 2.00%
3. Detectable warning domes will cover 2'-0" length and full width of the ramp floor as shown on sheet 13 of 15.
4. See NCDOT Roadway Std. Drawing 852.01 for concrete island dimensions.

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CURB RAMPS MEDIAN ISLANDS

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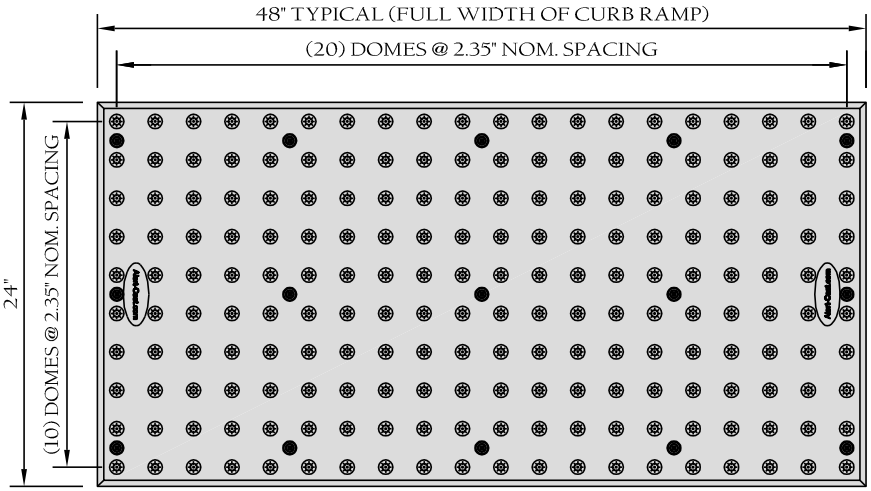
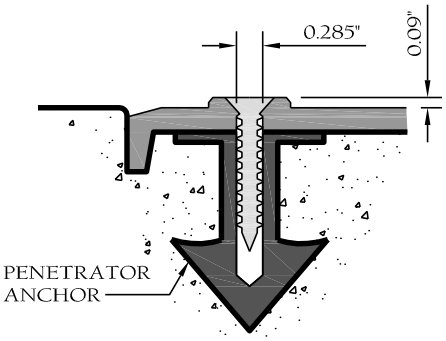
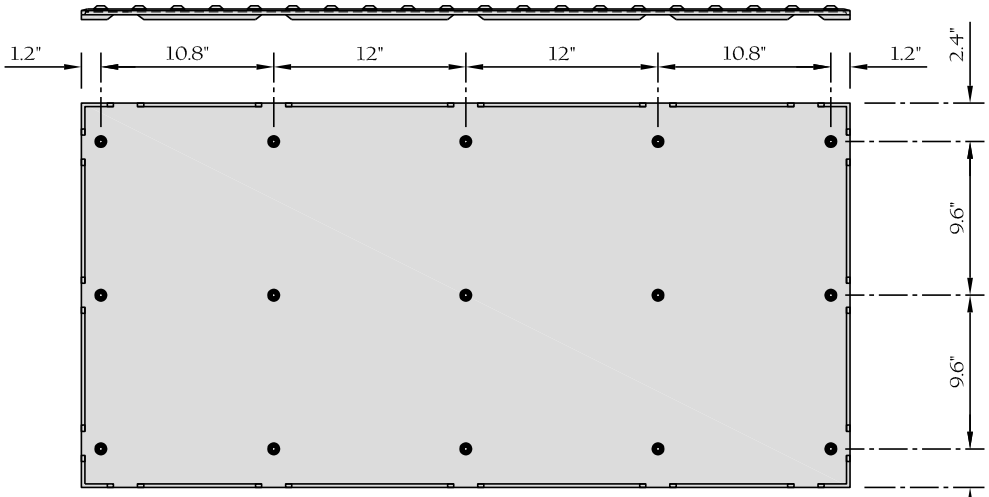
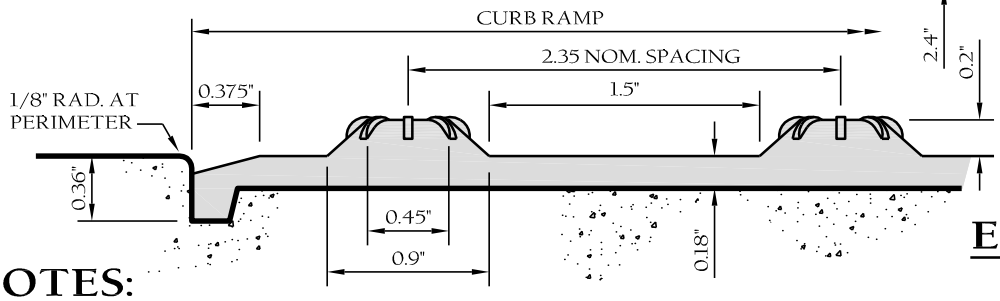




PENETRATOR SECTION





END SECTION

NOTES:

1. Detectable warning System. Cast in place with Penetrator anchors. See pre-approved products list.
2. Other sizes available to meet site specific requirements. Verify with Town.
3. Truncated domes in a detectable warning surface shall have a base diameter of 0.9 inch minimum to 1.4 inches maximum, a top diameter of 50% of the base diameter minimum to 65% of the base diameter maximum, and a height of 0.2 inches.
4. Truncated domes in a detectable warning surface shall have a center-to-center spacing of 1.6 inches minimum and 2.4 inches maximum, and a base-to-base spacing of 0.65 inches minimum, measured between the most adjacent domes on square grid.
5. Detectable warning surfaces shall extend 24 inches minimum in the direction of travel and the full width of the curb ramp, landing, or blended transition. The edge nearest the curb line shall be a minimum of 6 inches and a maximum of 8 inches from curb (ICC/ANSI A117.1 Fig C406.13.2). See notes 21 & 22.
6. See note 23, sheet 5.
7. Any NCDOT street must conform to DOT standard/ADA Curb Ramp detail 848.05 sheet 1-4.

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STANDARD DETECTABLE WARNING SYSTEM

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STANDARD NOTES:

1. North Carolina General Statute 136-44.14 requires that all street curbs being constructed or reconstructed for maintenance procedures, traffic operations, repairs, correction of utilities or altered for any reason after September 1, 1973 shall provide curb ramps for the physically disabled at all intersections where both curb and gutter and sidewalks are provided and at other points of pedestrian flow.
   In addition, section 228 of the 1973 Federal Aid Highway Safety Act requires provision of curb ramps on any curb construction after July 1, 1976 whether a sidewalk is proposed initially or is planned for a future date.
   The Americans with Disability Act (ADA) of 1990 extends to individuals with disabilities. Comprehensive civil rights protections similar to those provided to persons on the basis of race, sex, national origin and religion under the Civil Rights Act of 1964. These curb ramps have been designed to comply with the current ADA standards (2010 ADA Standards for Accessible Design, dated September 15, 2010 & effective March 15, 2012).
2. Curb ramps are required when streets are altered for resurfacing (spanning one intersection to another and includes overlay of additional material to the road surface with or without milling), reconstructed, rehabilitated or widened. Maintenance activities on streets, such as crack filling sealing, pavement markings, surface sealing and pavement patching, are not alterations. However, if there is no block-to-block resurfacing but resurfacing is occurring at a crosswalk itself, partial resurfacing (curb-to-curb resurfacing of a crosswalk) requires the provision of curb ramps at that crosswalk.
   Curb ramps are not required in the absence of a pedestrian walkway with a prepared surface nor are curb ramps required in the absence of curb, elevation or other barrier between the street and the walkway. [USDOJ July 8, 2013]
3. Curb ramps are required at all curb returns.
4. Detectable warning domes are required for curb ramps.
5. Single curb ramp at the center of the return are not permitted.
6. Dimensions assume 90° centerline intersection of streets.
7. Construct the ramp surface to be stable, firm and slip resistant. Located and construct the curb ramp type as shown in these details.
8. Curb ramps shall be constructed perpendicular to the roadway travel lane.
9. Coordinate the curb ramp and pedestrian crosswalk markings so a 4'x4' clear space at the base of the curb ramp will fall within the pedestrian crosswalk lines.
10. Set back distance from inside corner of an intersection crosswalk marking to nearest edge of travel lane is 4 feet minimum.
11. Terminate parking a minimum of 20 feet back of a pedestrian crosswalk.
12. Construct a curb ramps a minimum of 4 feet wide. Width may exceed 48".
13. Construct the running slope of the ramp at a maximum of 8.33% (1 : 12).
14. Allowable cross slope on sidewalks and ramps to be a maximum of 2%.
15. Construct the side flare slope to a maximum of 10% measured along the curb line.;
16. Construct the counter-slope of the gutter or street at the base of the curb ramp at a maximum of 5% and maintain a smooth transition.
17. Construct landings for sidewalk at a minimum of 4'x4' with a maximum slope of 2% in any direction. Construct landings for median islands a minimum of 5'x5' with a maximum slope of 2% in any direction.
18. To use a median island as a pedestrian refuge area, median islands will be a minimum of 6 feet wide. Construct median islands to provide passage over or through the island.
19. Small channelization islands that cannot provide a 5'x5' landing at the top of a curb ramp, will be cut through level with the surface of the street.
20. Curb ramps with returned side curbs may be used only where pedestrians would not normally walk across the ramp such as where there the adjacent surface is plantings, other non-walking surface, or the side approach is substantially obstructed.
21. The typical 2'x4' truncated dome pad shall be placed with the short dimension perpendicular to the curb. See curb ramp typical details. Truncated dome pads shall abutt the back of the curb (ICC/ANSI A117.1 Fig C406.13.2).
22. Curved truncated dome pads are permitted when ramp width is greater than 4 feet.
23. Color contrast required only when detectable warning plates are employed. (ADA Standards for Accessible Design, section 705, Latest Edition). Recommended Min. light reflectance contrast is 70% (American National Standard ICC/ANSI A117.1 - Standard & Commentary Section 705.3, Latest Edition). Painted surface will not be acceptable. (See note 4).
24. Place a 1/2-inch expansion joint where the concrete curb ramp joins/abuts the curb.
25. Curb ramps through median islands, single ramps at dual crosswalks or limited right-of-way situations will be handled by special details. Consult with the Town Engineer.
26. When construction is on a NCDOT Right-of-Way, construction shall conform to the latest edition of the NCDOT Roadway Standard drawings.
27. Construction of curb ramps shall conform to the latest edition of the ICC/ANSI A117, Chapter 4 Accessible Routes.

STANDARD NOTES (continued):

28. Curb ramps shall be provided at locations as shown on these plans or as directed by the engineer. Curb ramps shall be located as indicated in these details; however, the location may be adjusted as directed by the engineer where existing light poles, fire hydrants, drop inlets, etc. Affect placement. At these locations, not less than 2 feet of full height curb shall be placed between adjacent ramps.
29. Use air entrained 3000 psi concrete with a sidewalk finish in order to obtain a rough non-skid type surface.
30. Crosswalk widths and configuration vary but must conform to traffic design standards.
31. Place the inside pedestrian crosswalk lines no closer in the intersection then would be established by bisecting the intersection radii, with an allowance of a 4'x4' maneuvering space (2003 ICC/ANSI a117 Commentary. Fig. C406.6 & 406.10) in the vehicular travel way when one ramp is installed.
32. Place all pavement markings 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.
33. For asphalt greenways transition greenway to concrete to enable truncated dome placement.
34. Concrete must come from a ready mix concrete truck to ensure mix meets air entrainment requirements. No site mix or sakrete mix allowed.

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RESERVED
FUTURE DETAIL

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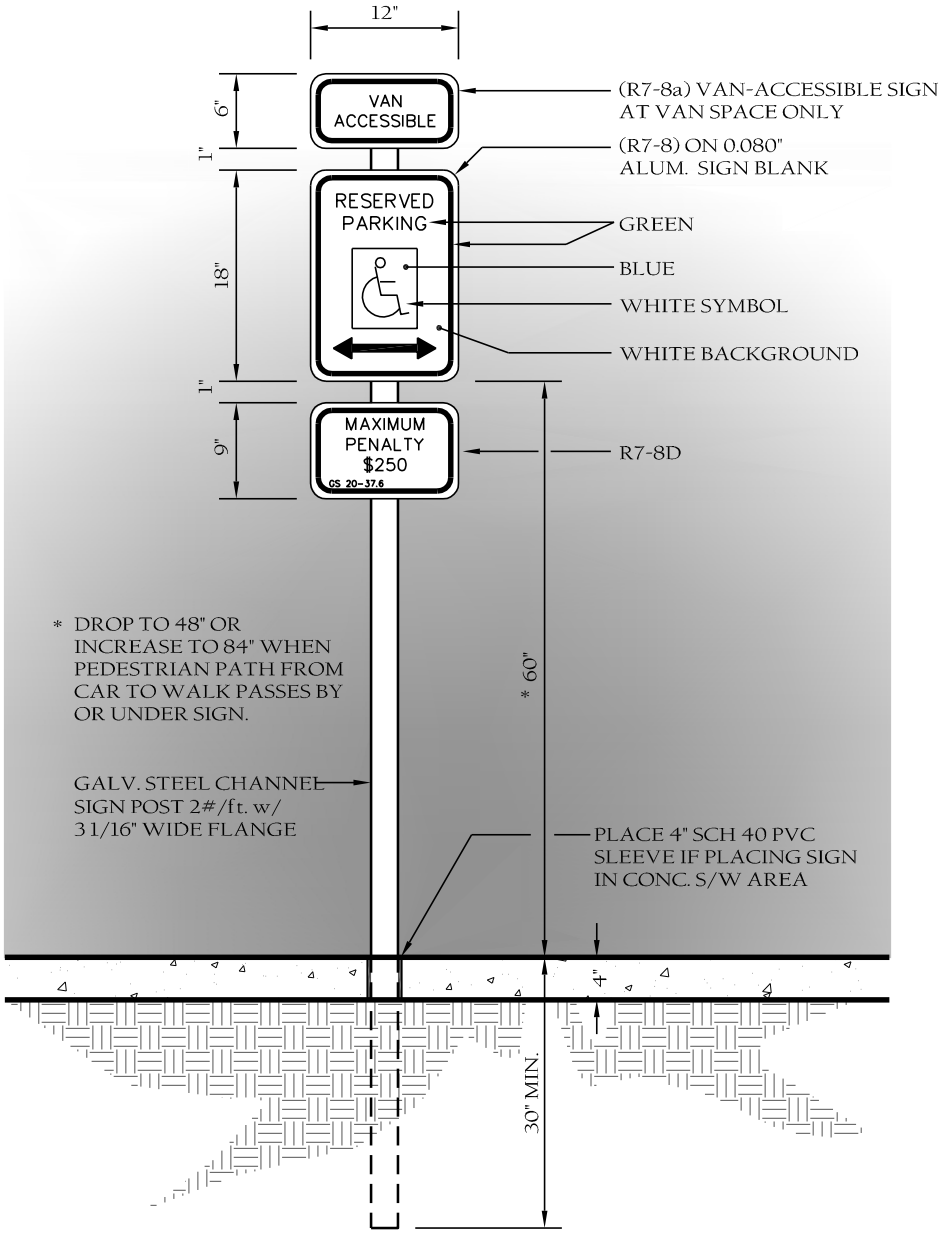

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R7-8 HANDICAP SIGN DETAIL

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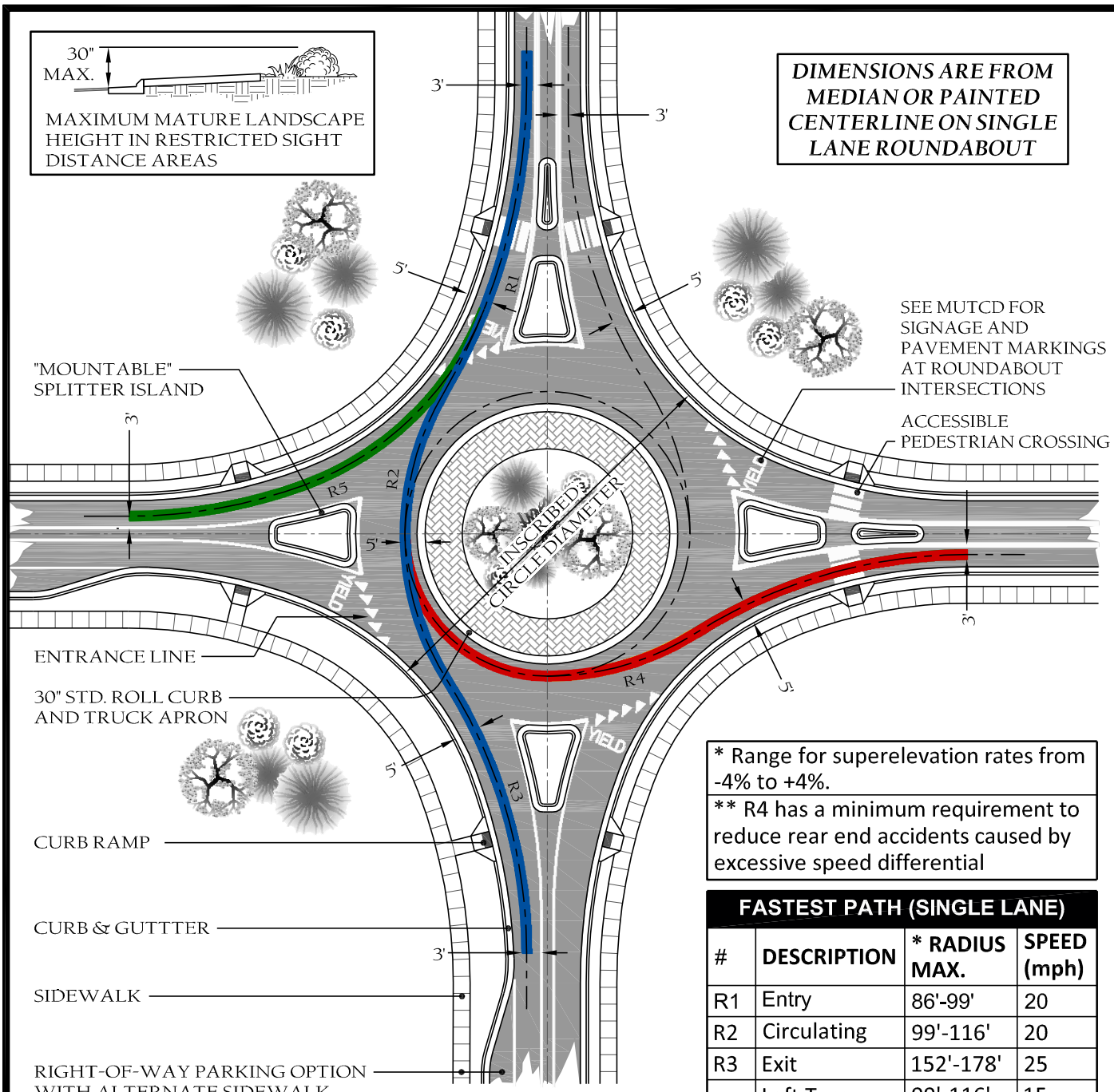
MAXIMUM MATURE LANDSCAPE HEIGHT IN RESTRICTED SIGHT DISTANCE AREAS

DIMENSIONS ARE FROM MEDIAN OR PAINTED CENTERLINE ON SINGLE LANE ROUNDABOUT



* Range for superelevation rates from -4% to +4%.

** R4 has a minimum requirement to reduce rear end accidents caused by excessive speed differential

FASTEST PATH (SINGLE LANE)

#	DESCRIPTION	* RADIUS MAX.	SPEED (mph)
R1	Entry	86'-99'	20
R2	Circulating	99'-116'	20
R3	Exit	152'-178'	25
R4	Left Turn	99'-116'	15
	Minimum **	18'-20'	10
R5	Right Turn	152'-178'	20

NOTES:

1. *Decision Sight Distance (DSD) and Stopping Sight Distance (SSD) must be checked for horizontal and vertical alignment. DSD & SSD are measured along vehicle path.*
2. *SSD for pedestrians measured to point 6' behind curb.*
3. *Refer to the FHWA Technical Summary on Roundabouts for considerations in the design section & implementation of Roundabouts (FHWA-SA-10-006, latest revision).*

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ROUNDABOUT STANDARD DETAIL

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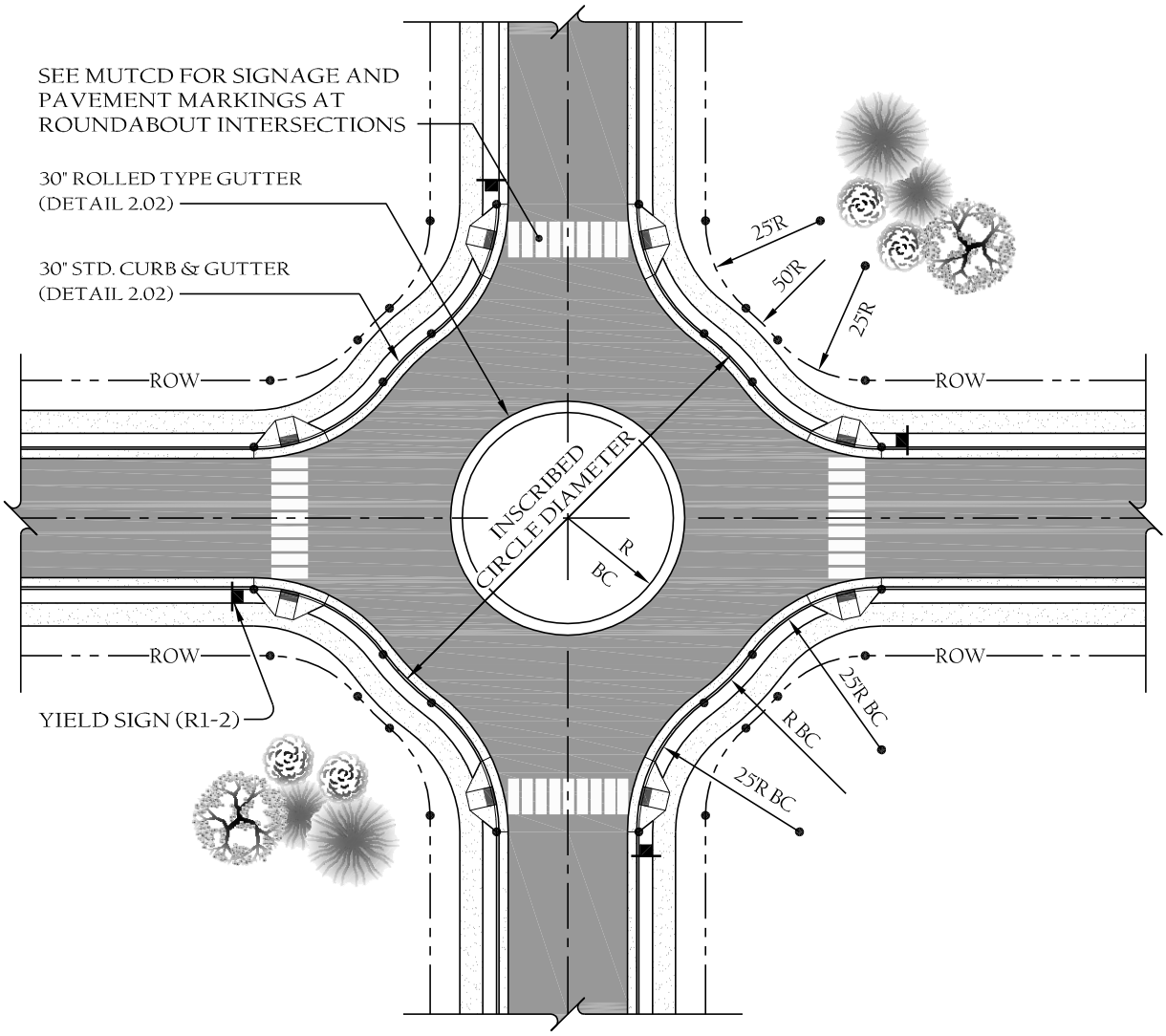

NOTES:

1. *Decision Sight Distance (DSD) and Stopping Sight Distance (SSD) must be checked for horizontal and vertical alignment. DSD & SSD are measured along vehicle path.*
2. *SSD for pedestrians measured to point 6' behind curb.*
3. *Refer to the FHWA Technical Summary on Roundabouts for considerations in the design section & implementation of Neighborhood Traffic Circles (FHWA-SA-10-006, latest revision).*
4. *Dimensions shown are minimum and to be verified with a traffic design. Coordinate design with Town Engineer.*
5. *R1-2 is a MUTCD sign designations (Manual on Uniform Traffic Control Devices.)*

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ROUNDABOUT STANDARD DETAIL

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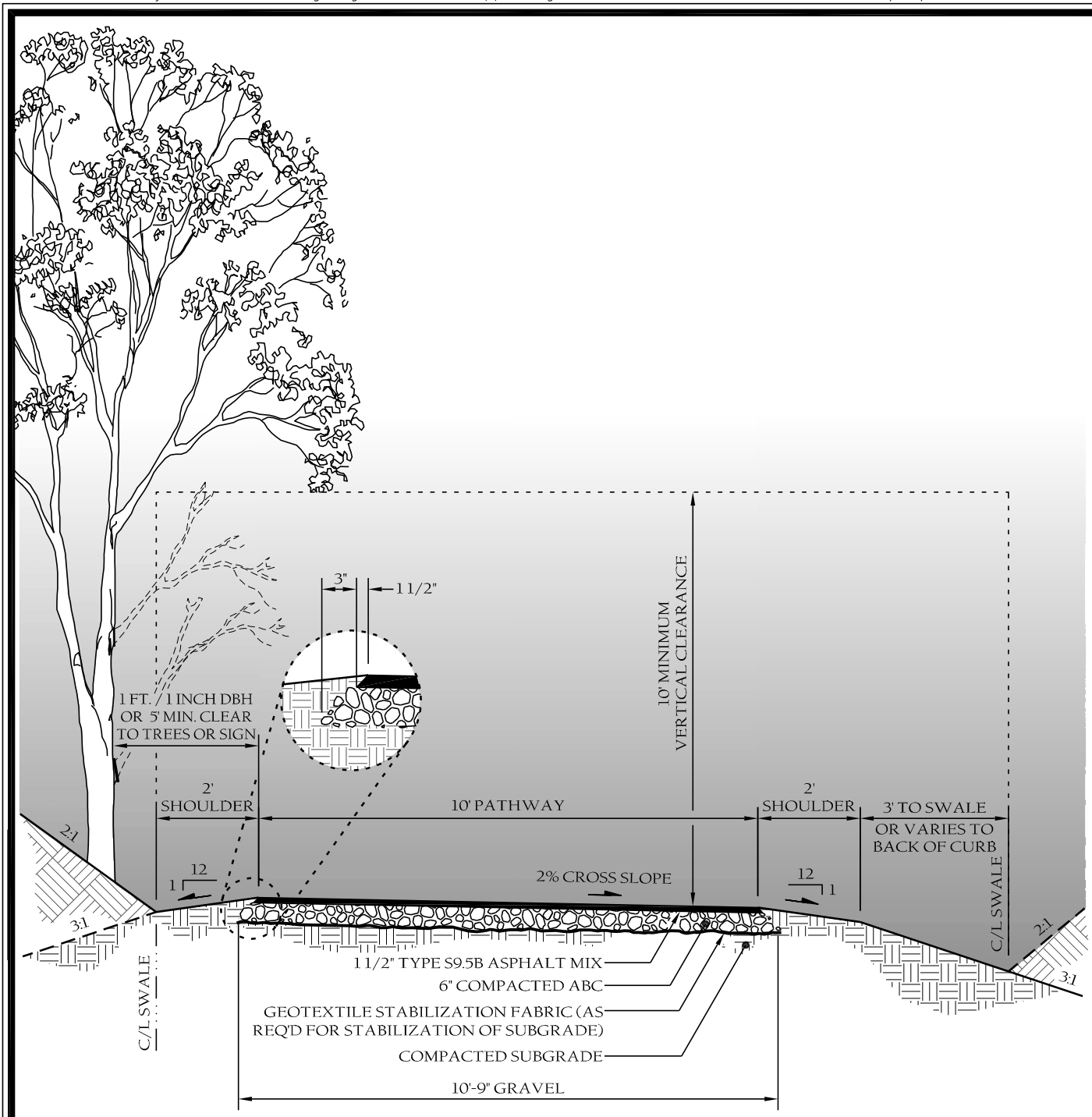

ASPHALT SECTION

PAVED

TOWN of WAKE FOREST

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MULTI-USE PATH DETAIL

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Not To Scale	9.17
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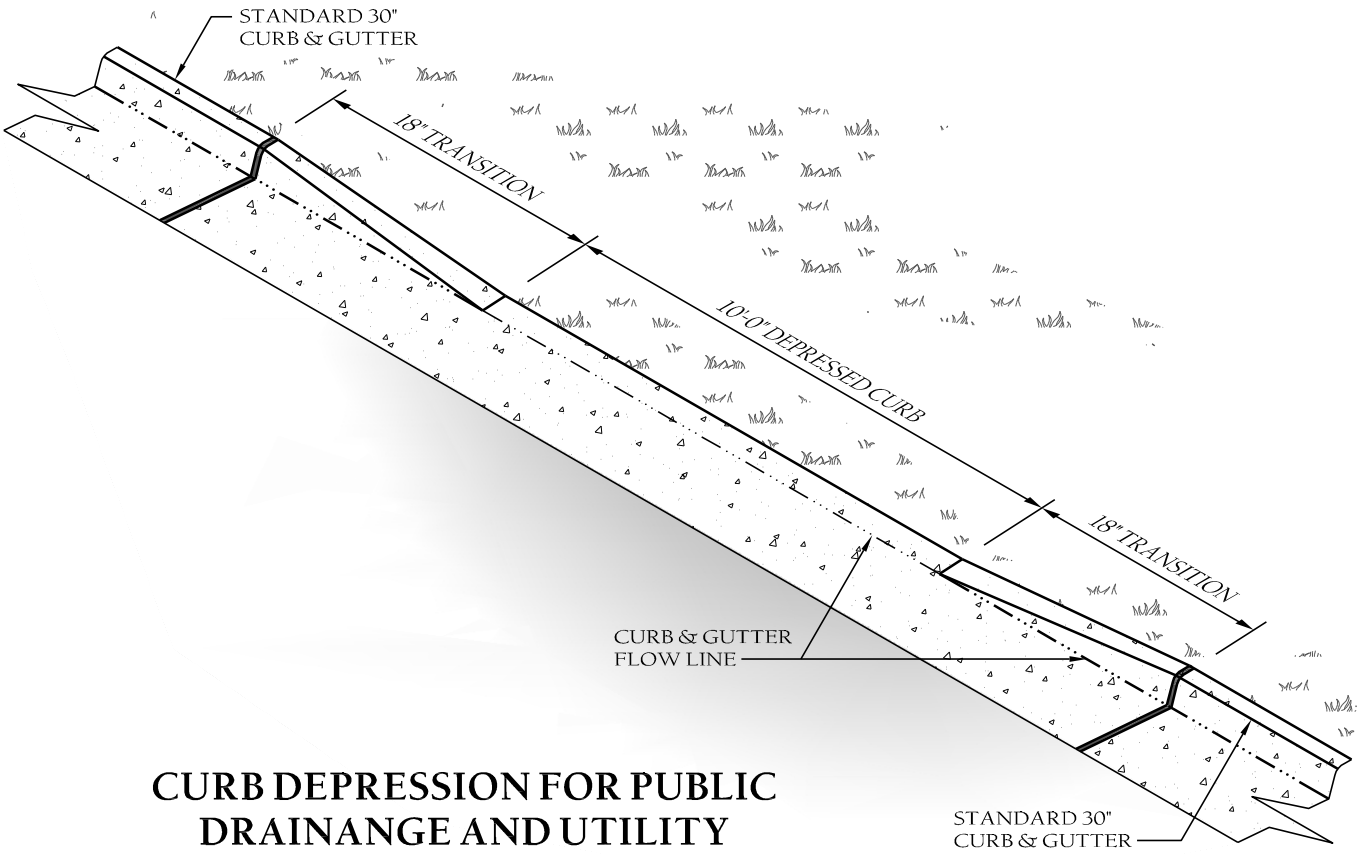

CURB DEPRESSION FOR PUBLIC DRAINANGE AND UTILITY EASEMENT ACCESS

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10' CURB DEPRESSION

Scale:	Detail #:
Not To Scale	9.18
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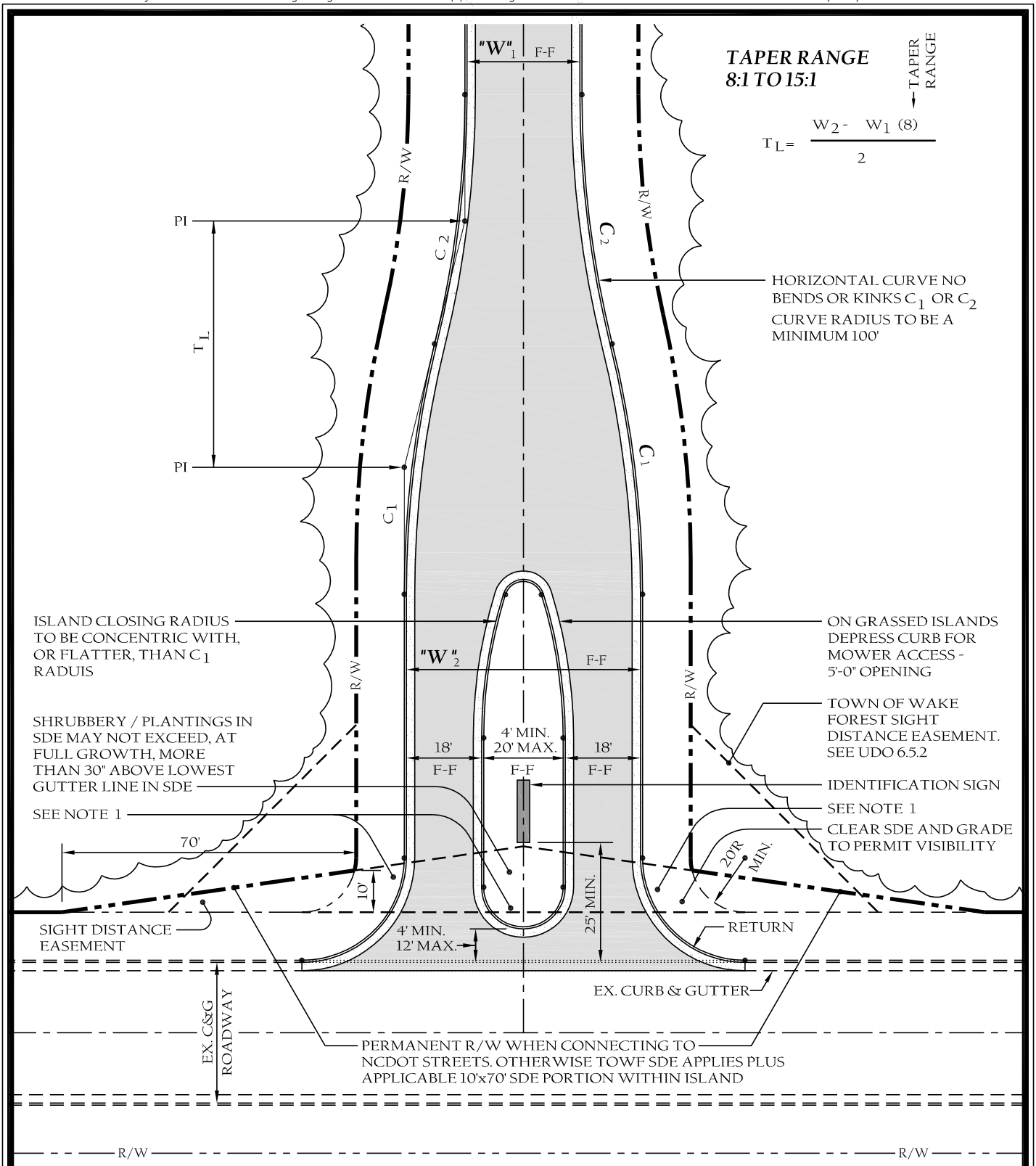

NOTES:

1. Refer to curb ramp details for requirements where sidewalks ar required

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ISLAND ENTRANCE TO EXISTING CURB & GUTTER

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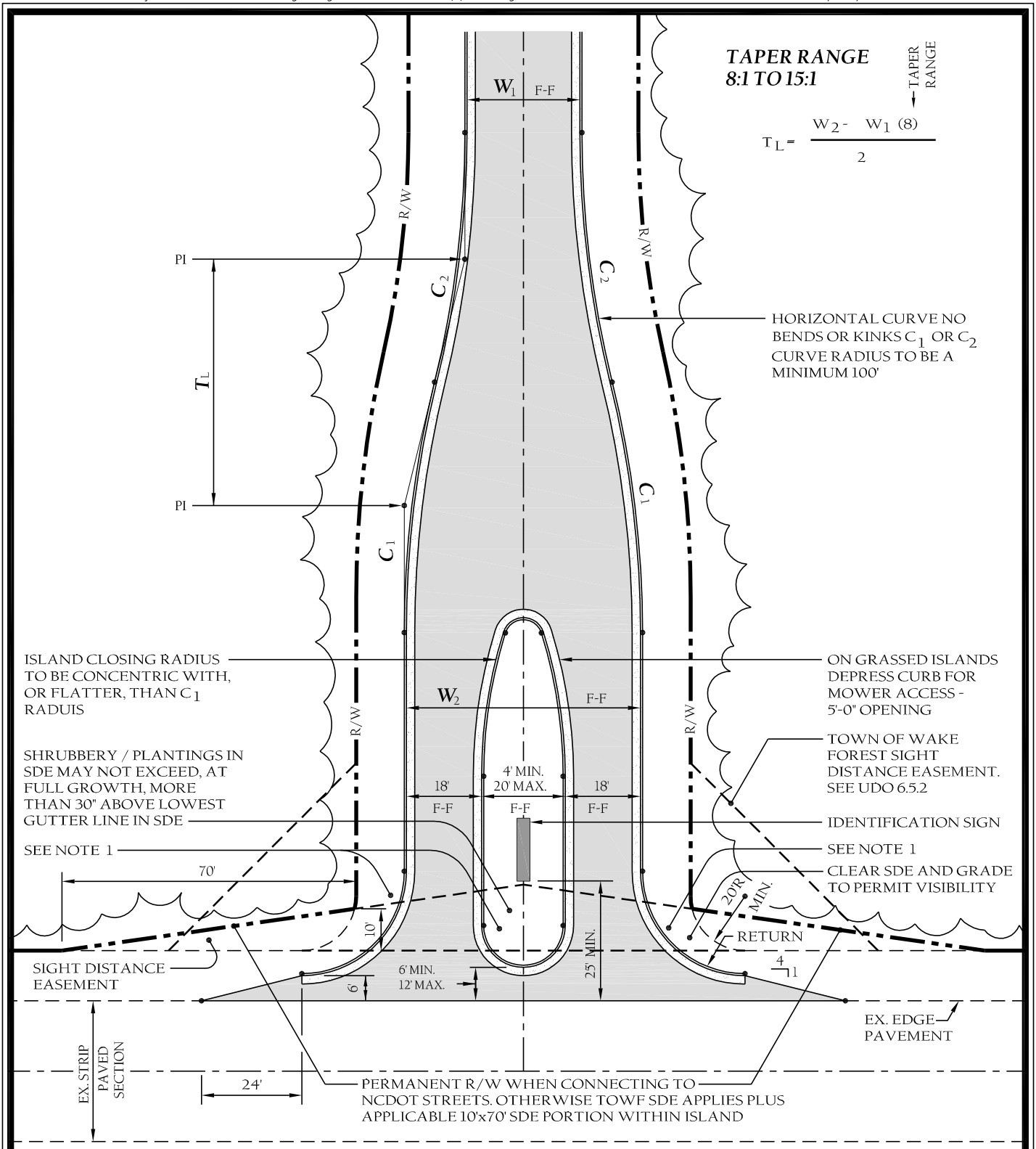

NOTES:

1. Refer to curb ramp details for requirements where sidewalks ar required

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ISLAND ENTRANCE TO EXISTING STRIP PAVED

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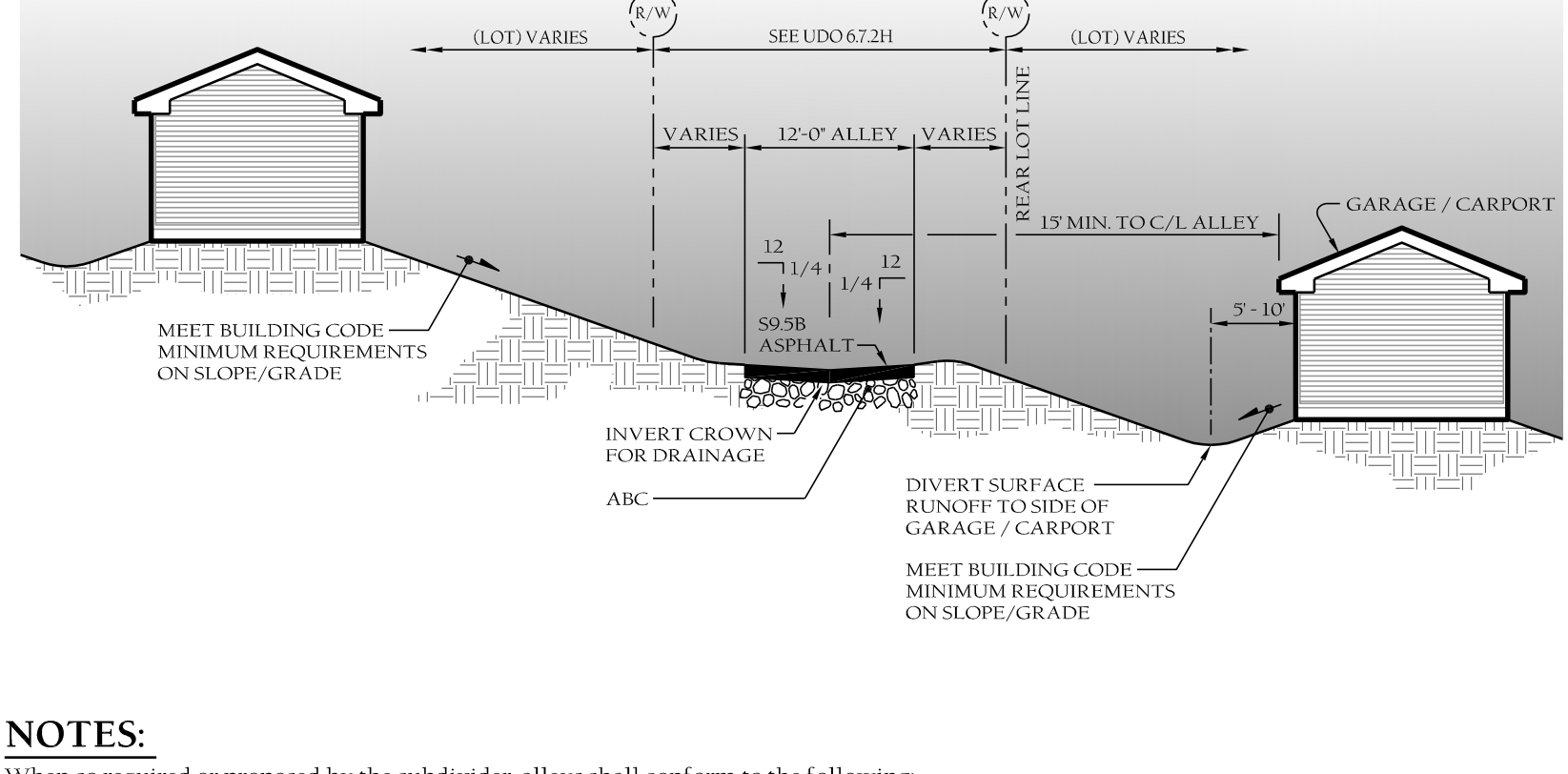
Details Provided by APPIAN Consulting Engineers – www.appianengineers.com 03/09/2015 – 5:23:20 PM



NOTES:

When so required or proposed by the subdivider, alleys shall conform to the following:

1. Property line radius at intersections.....20 ft.
2. Minimum radius to centerline when deflection angle of more than 10 degrees occurs.....35 ft..
3. Pavement radius at intersecting street.....20 ft.
4. See UDO 6.7.2 for other requirements.

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TYPICAL SERVICE ALLEY DETAIL

Scale: Not To Scale

Detail #: 9.20

Revision Date: Feb, 2015

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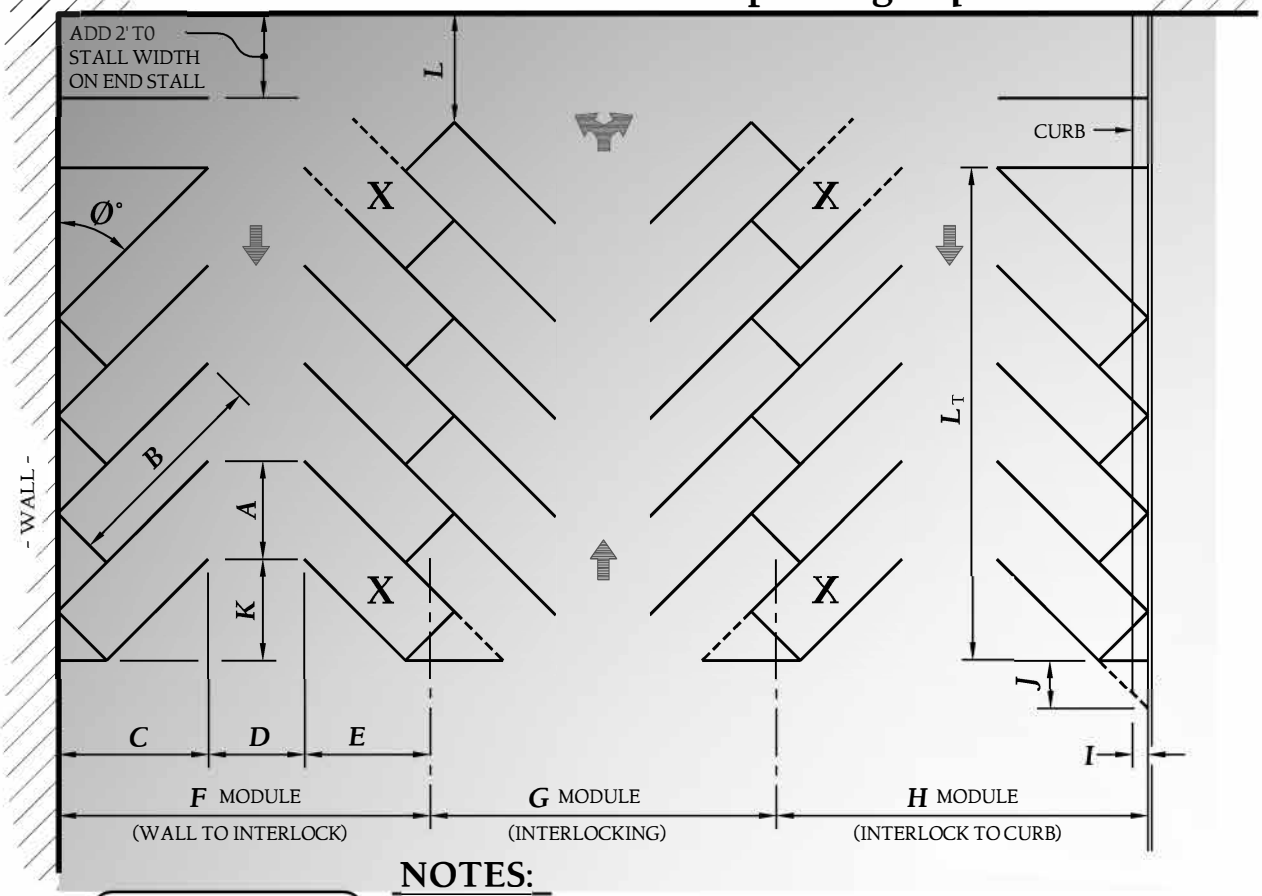
Note: See UDO 9.4 & 9.5 for other parking requirements.



L_T = TOTAL LENGTH AVAILABLE

$\frac{L_T - K}{A}$ = # SPACES PER ROW

NOTES:

X - *STALL NOT ACCESSIBLE IN CERTAIN LAYOUTS*

90° MUST HAVE 2 WAY ISLES

STALL LAYOUT ELEMENTS. SOURCE:
BASED ON PARKING PRINCIPLES, SPECIAL REPORT NO. 125, HIGHWAY RESEARCH BOARD, WASHINGTON, D.C., 1971, P99.

PARKING LAYOUT DIMENSIONS at VARIOUS ANGLES

(DIMENSION IN FEET)

Dimension	On Diagram	STANDARD CARS (9'x18' STALLS) ANGLE Ø° 45°	60°	75°	90°	COMPACT CARS (8'x16' STALLS) ANGLE Ø° 45°	60°	75°	90°
Stall width, parallel to aisle	A	12.7	10.4	9.3	9.0	11.3	9.2	8.3	8
Stall length of line	B	27.5	23.7	20.9	18.5	24.0	20.6	18.1	16
Stall depth to wall	C	19.5	20.5	20.0	18.5	17.0	17.9	17.5	16
Aisle width between stall lines	D	12.0	16.0	23.0	26.0	12.0	16.0	20.0	22
Stall depth, interlock	E	16.5	18.5	19.0	18.5	14.2	15.9	16.5	16
Module, wall to interlock	F	48.0	55.0	62.0	63.0	43.2	49.8	54.0	54
Module, interlocking	G	45.0	53.0	61.0	63.0	39.3	47.3	53.0	52
Module, interlock to curb face	H	46.0	52.5	59.5	60.5	40.7	48.0	52.0	50
Bumper overhang (typical)	I	2.0	2.3	2.5	2.5	1.5	1.8	2.0	2
Offset	J	6.4	2.6	0.6	0.0	5.7	2.3	0.6	0
Setback	K	13.1	9.3	4.8	0.0	11.3	8.0	4.1	0
Cross aisle, one-way	L	14.0	14.0	14.0	14.0	13.0	13.0	13.0	13
Cross aisle, two-way	-	24.0	24.0	24.0	24.0	20.0	20.0	20.0	20

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PARKING STALL LAYOUT

Scale: Not To Scale

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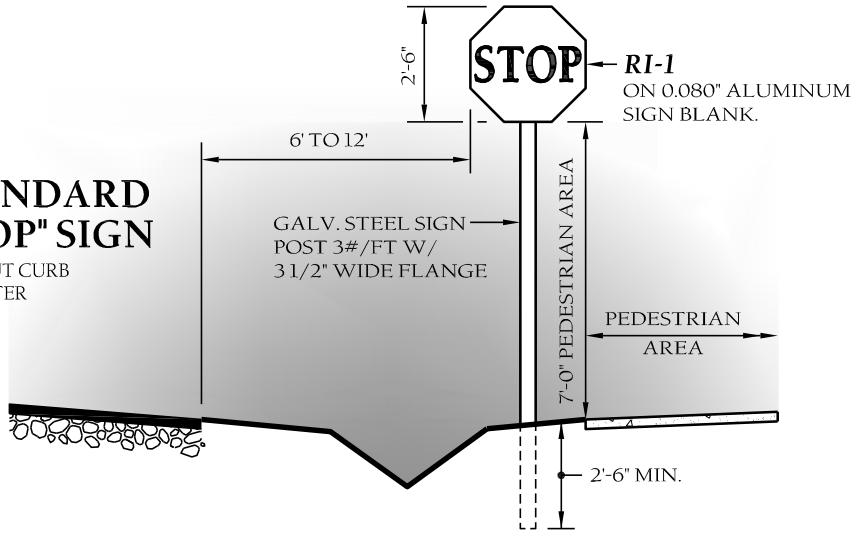
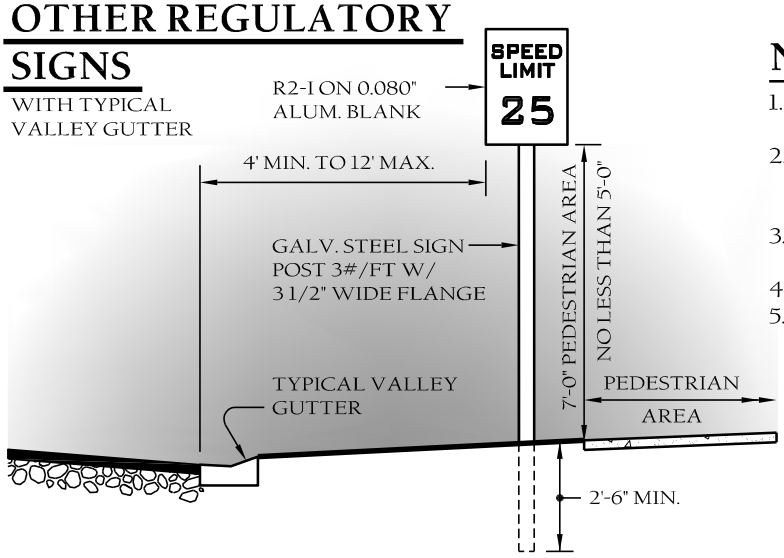
STANDARD "STOP" SIGN

WITHOUT CURB
OR GUTTER



OTHER REGULATORY SIGNS

WITH TYPICAL
VALLEY GUTTER

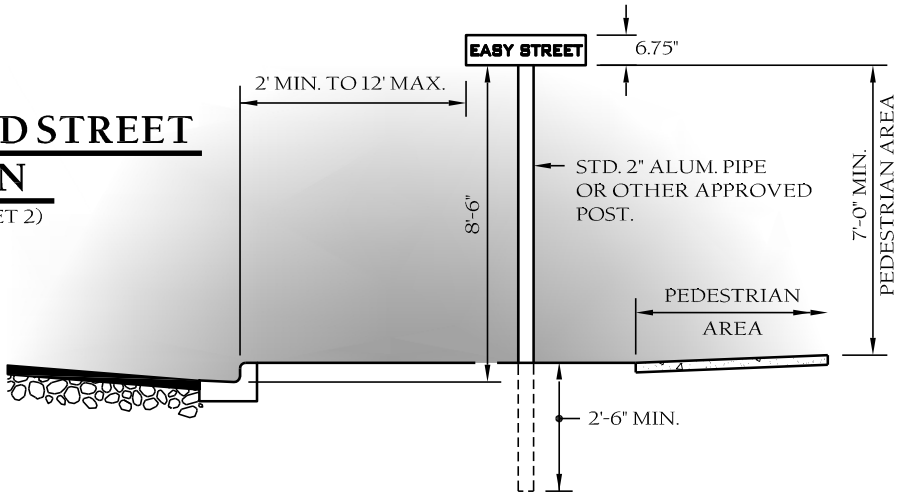


NOTES:

1. Street name signs shall be a minimum of extruded aluminum blades. See sheet 2.
2. All reflective signs shall be made of engineering grade or high intensity grade reflective sheeting or approved equivalent.
3. All signs placed in right-of-way will be approved by town's engineer.
4. Erect street signs plumb.
5. Developer shall be responsible for furnishing & erecting all street name & regulatory signs.

STANDARD STREET NAME SIGN

(SEE NOTES & SHEET 2)
WITH CONCRETE
CURB & GUTTER



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STANDARD SIGN INSTALLATION DETAIL

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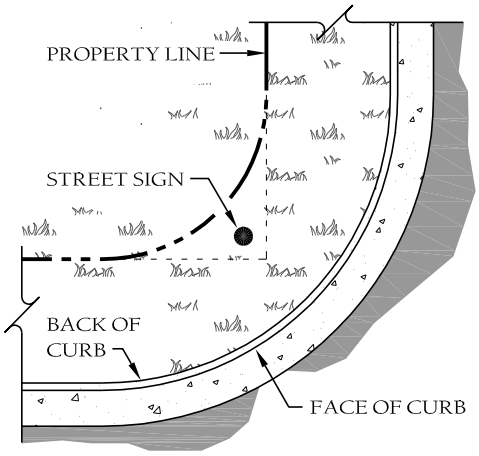
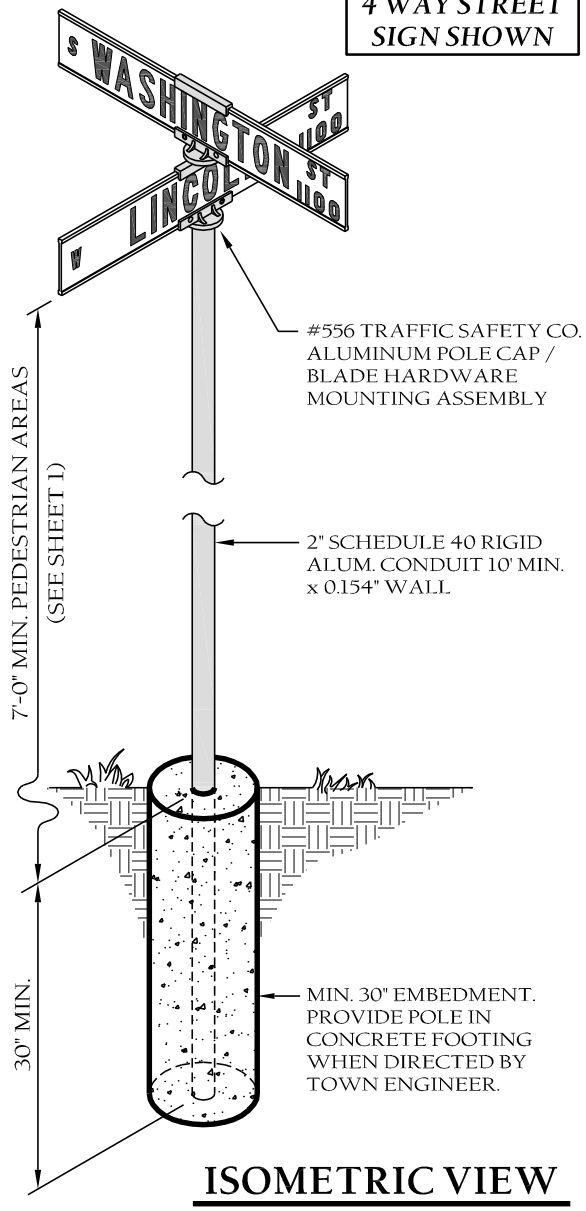
4 WAY STREET SIGN SHOWN



PLAN VIEW



ISOMETRIC VIEW

NOTES:

1. 4" letters to be series "C" (FHWA)
2. 2" letters to be series "C" (FHWA)
   All letters and background materials to be "Scotchlite" or an approved equal and meet I.T.E. Specifications on reflectivity.
3. Sign appearance shall be green background with white letters.
4. Fabricate sign as follows: Base sheeting shall be 3-M 3930 Hi-Intensity Prismatic (or equal). Overlay letter mask using 3-M 1177-C translucent EC green film. (Note: 3-M DG3 material acceptable alternative)
5. Aluminum sign blank materials to be 0.080" thick with extruded aluminum blades.

RECOMMENDED INSTALLATION

1. Street name sign to be one-foot from property line if said lines were extended.
2. Sign blades not to extend past back of curb into road.
3. Sign location to be placed on low side of block numbering.
4. Any exceptions shall be approved by the Town Engineer.
5. Developer responsible for installation of all street signs.

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RESIDENTIAL STREET NAME SIGNS 6 3/4" SIGN HEIGHT

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RESERVED
FUTURE DETAIL

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RESERVED FUTURE DETAIL

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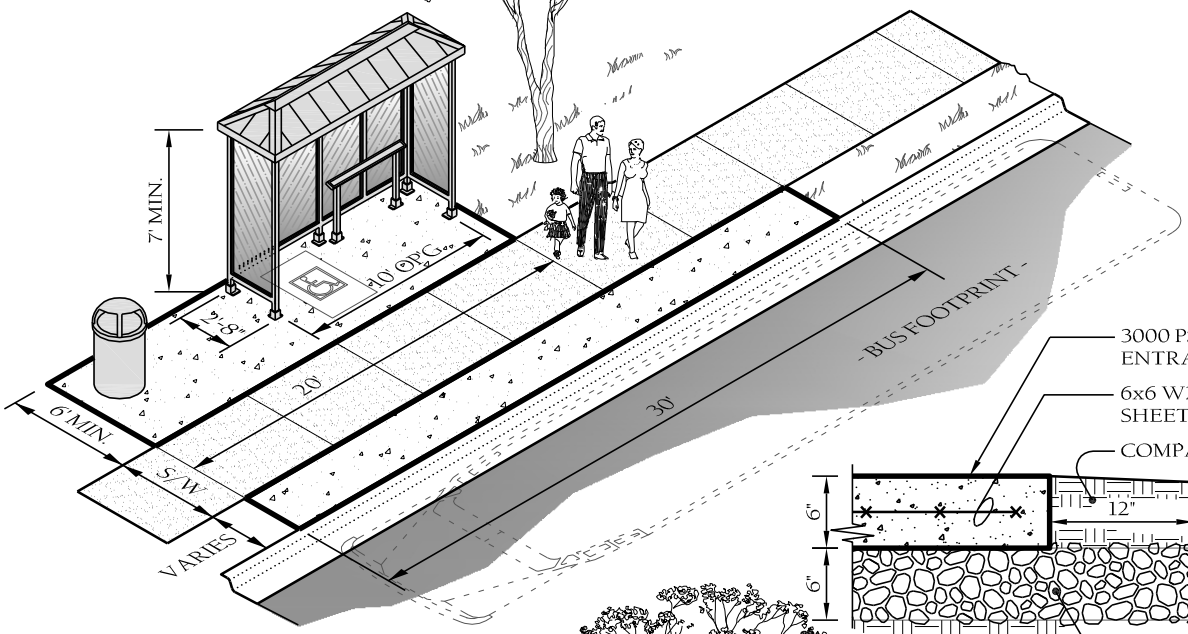
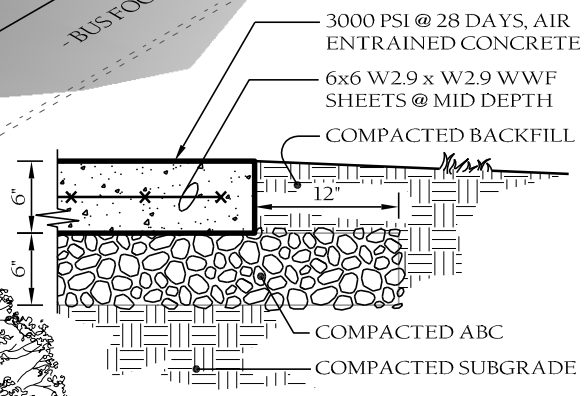
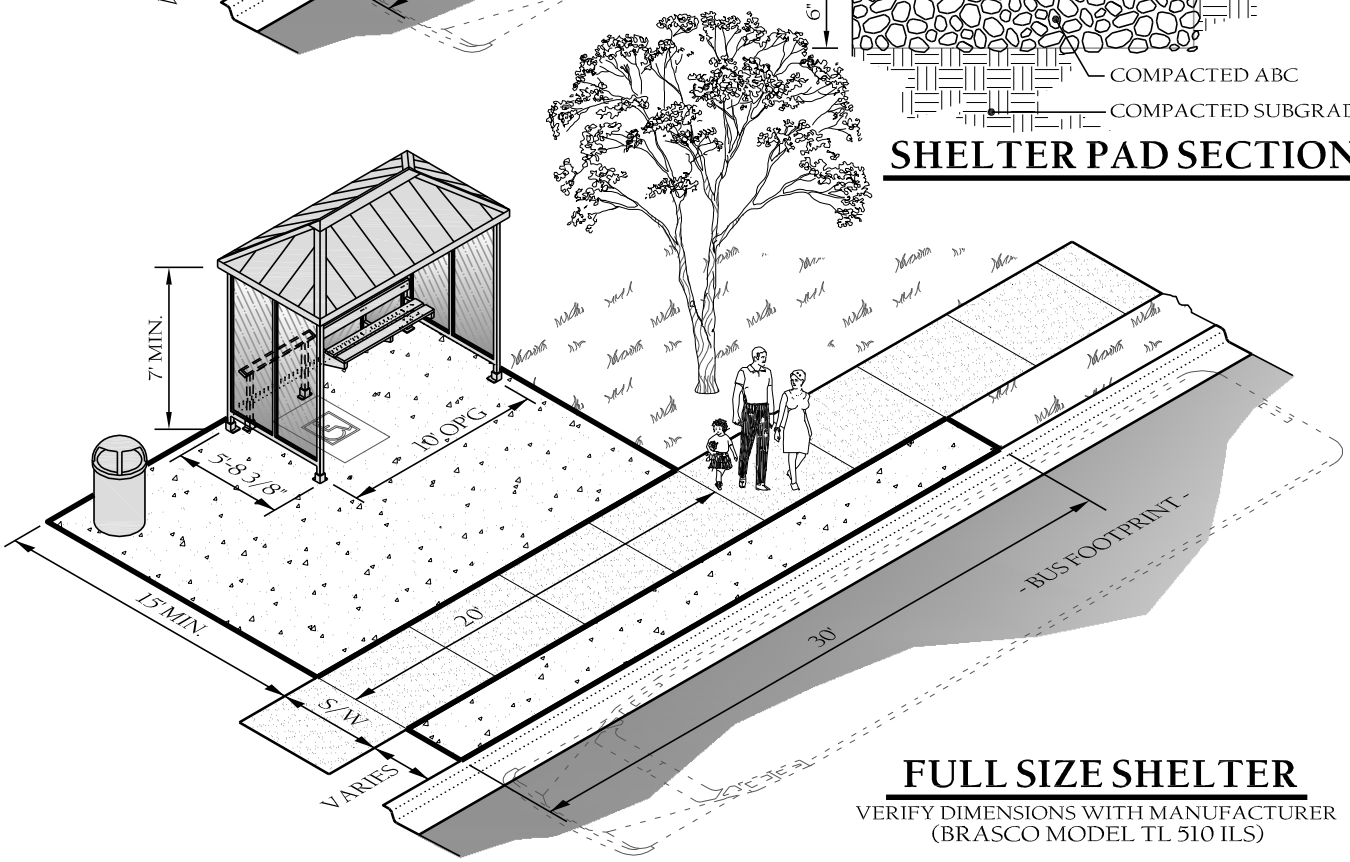
SLIMLINE SHELTER

VERIFY DIMENSIONS WITH MANUFACTURER
(BRASCO MODEL TL 510 C)





SHELTER PAD SECTION



FULL SIZE SHELTER

VERIFY DIMENSIONS WITH MANUFACTURER
(BRASCO MODEL TL 510 ILS)

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BUS SHELTER DETAILS

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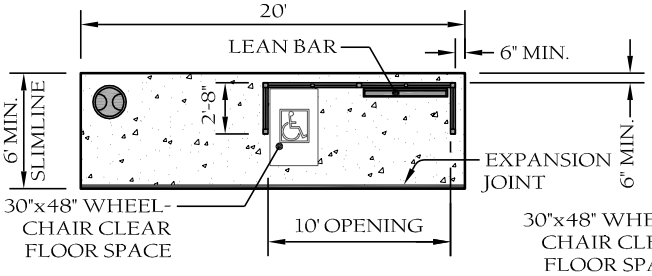
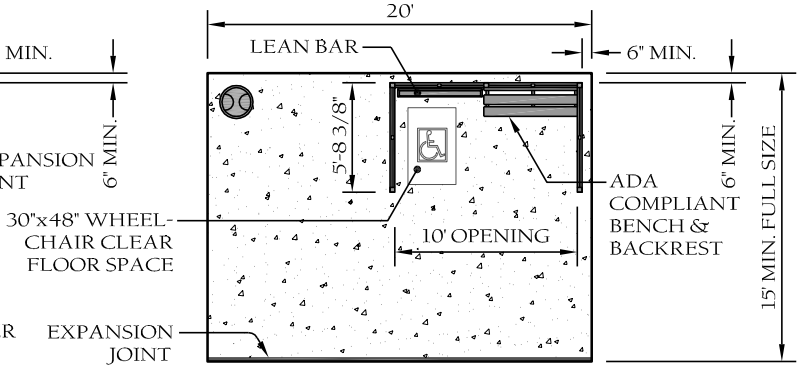


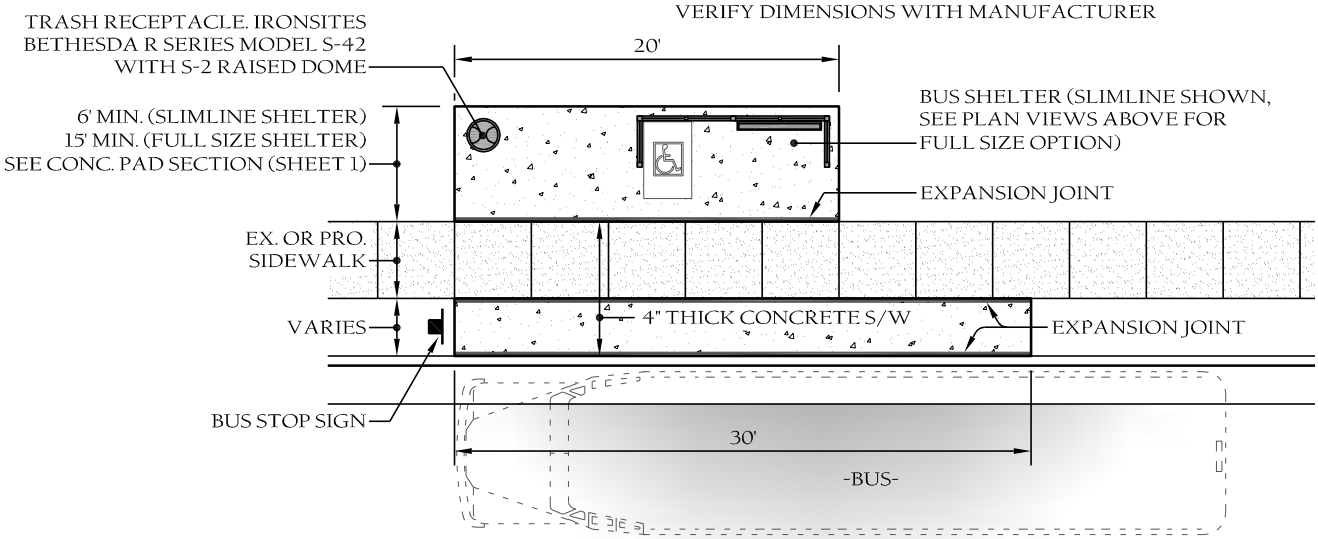
SLIMLINE SHELTER

VERIFY DIMENSIONS WITH MANUFACTURER

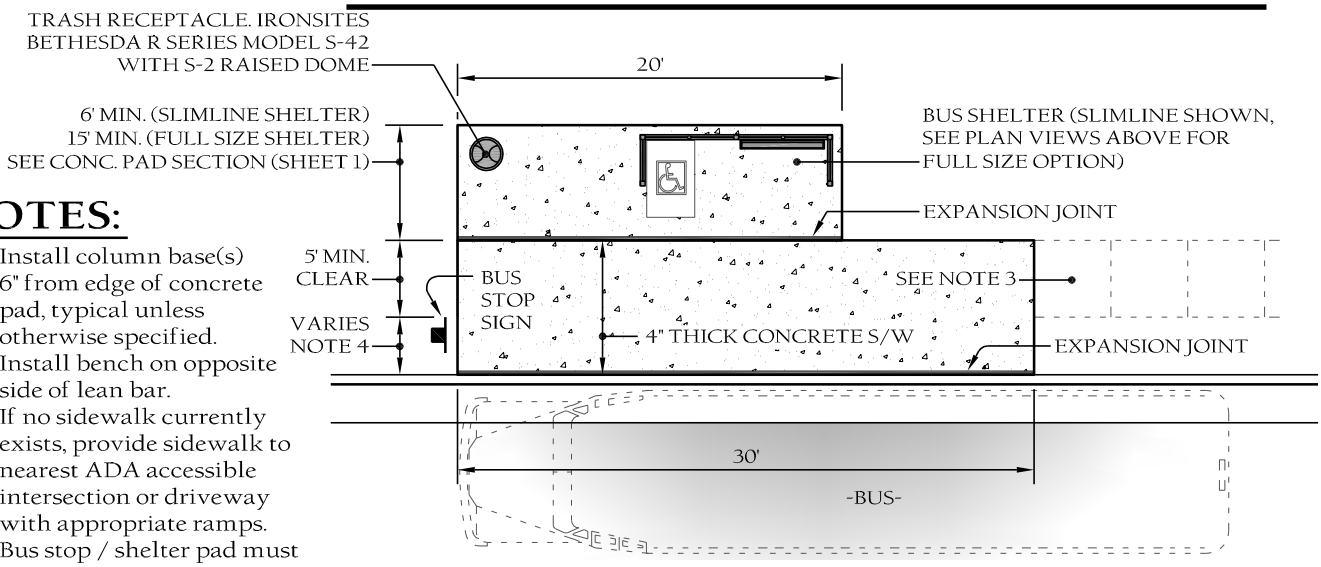


FULL SIZE SHELTER

VERIFY DIMENSIONS WITH MANUFACTURER



SHELTER LAYOUT WITH EXISTING SIDEWALK



SHELTER LAYOUT WITHOUT EXISTING SIDEWALK

NOTES:

1. Install column base(s) 6" from edge of concrete pad, typical unless otherwise specified.
2. Install bench on opposite side of lean bar.
3. If no sidewalk currently exists, provide sidewalk to nearest ADA accessible intersection or driveway with appropriate ramps.
4. Bus stop / shelter pad must be clear of utility poles, fire hydrants & other similar obstacles.
5. See UDO 6.7.2.

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BUS SHELTER DETAILS

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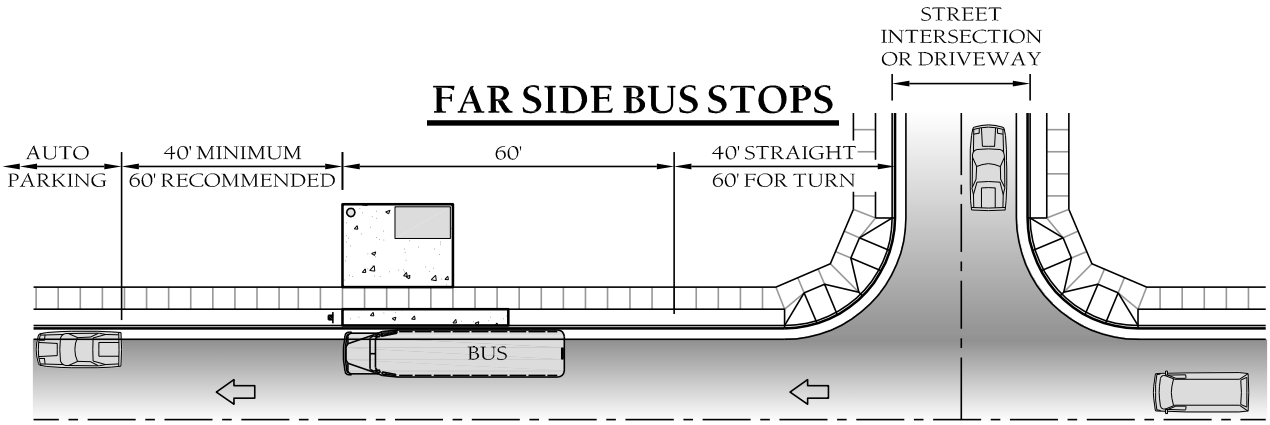
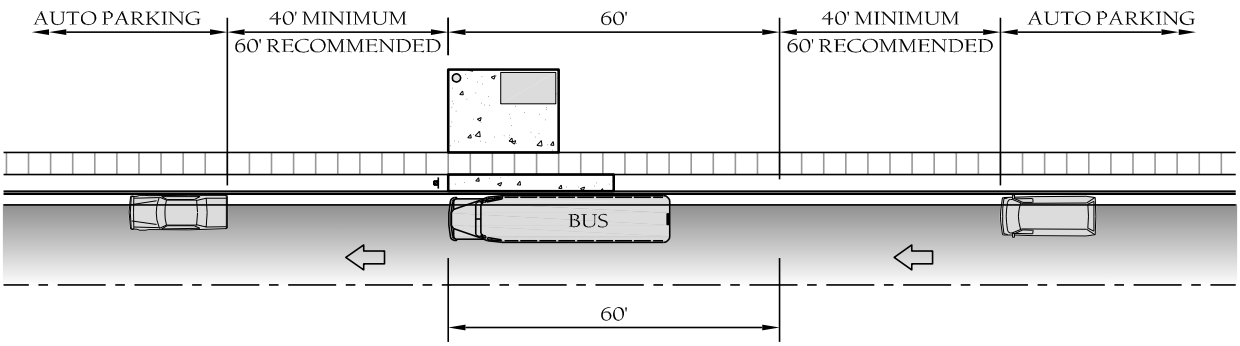
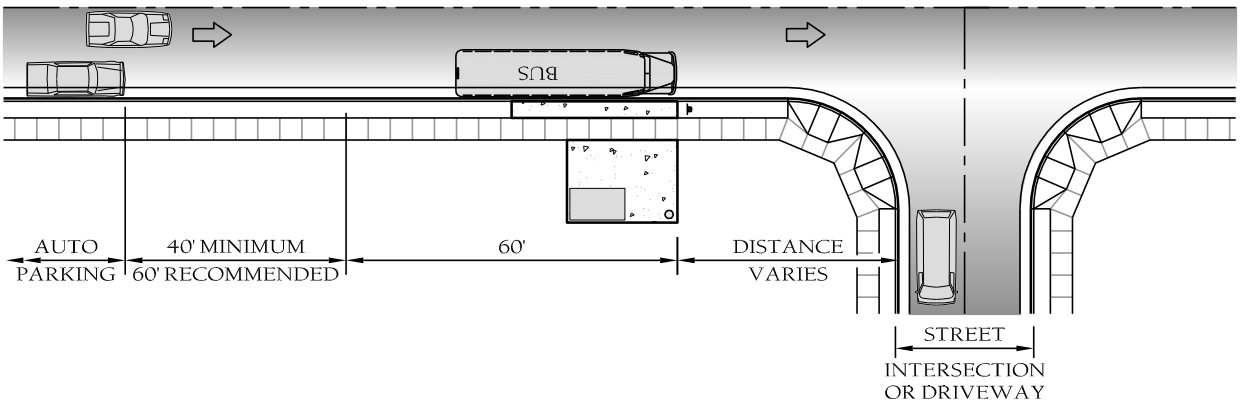
FAR SIDE BUS STOPS



MID BLOCK BUS STOPS



NEAR SIDE BUS STOPS



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BUS SHELTER DETAILS

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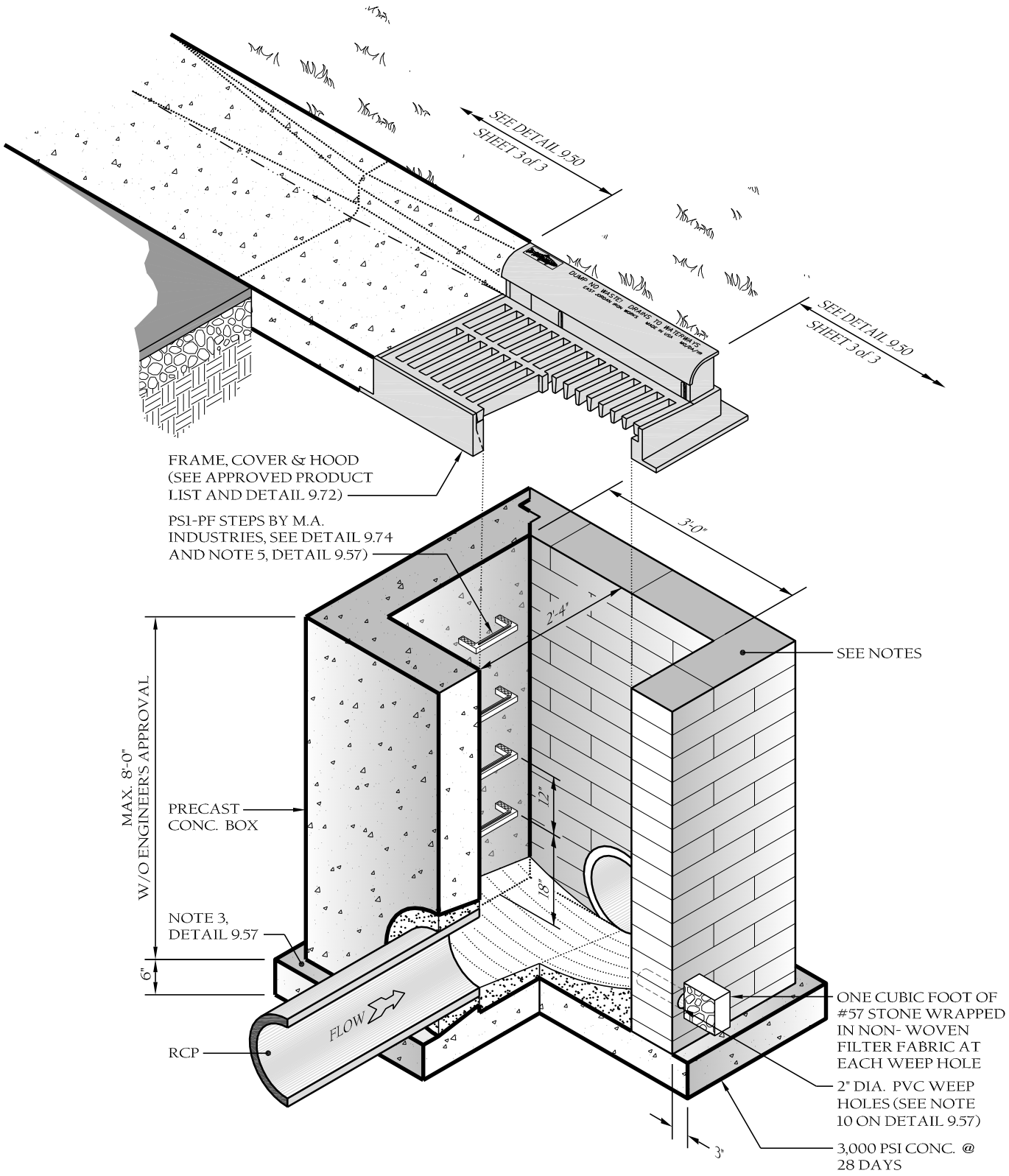

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STD. C&G INLET W/HOOD DETAIL

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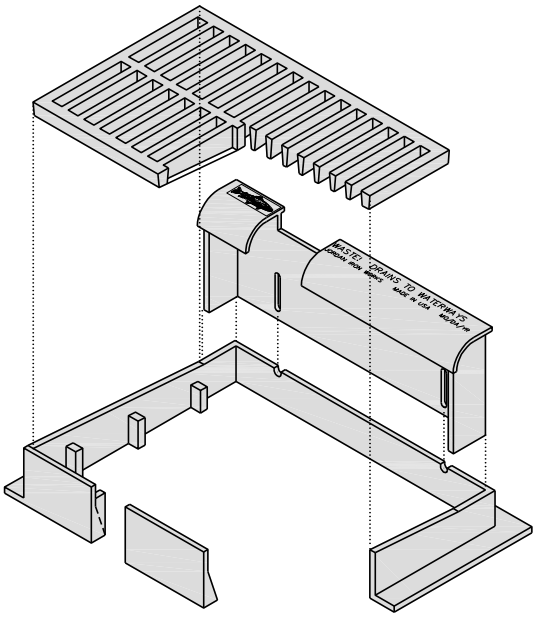
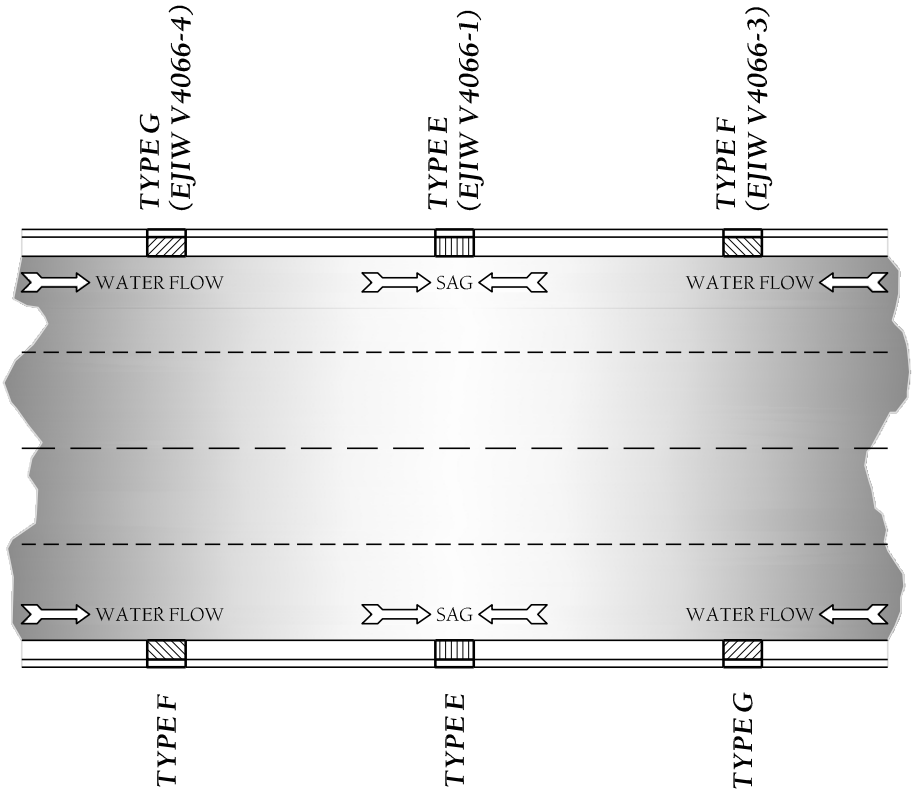
- SEE DETAIL 9.72 AND PRE-APPROVED PRODUCT LIST. (NCDOT DETAIL 840.03 - SHOWN WITH TYPE "E" GRATE) HEAVY DUTY FRAME, COVER & HOOD
- BIKE-FRIENDLY GRATES ARE REQUIRED AT BIKE/PEDESTRIAN CORRIDORS.





DETAIL SHOWING TYPES OF GRATES TO BE USED ACCORDING TO WATER FLOW

TOWN of WAKE FOREST

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STD. C&G INLET W/HOOD DETAIL

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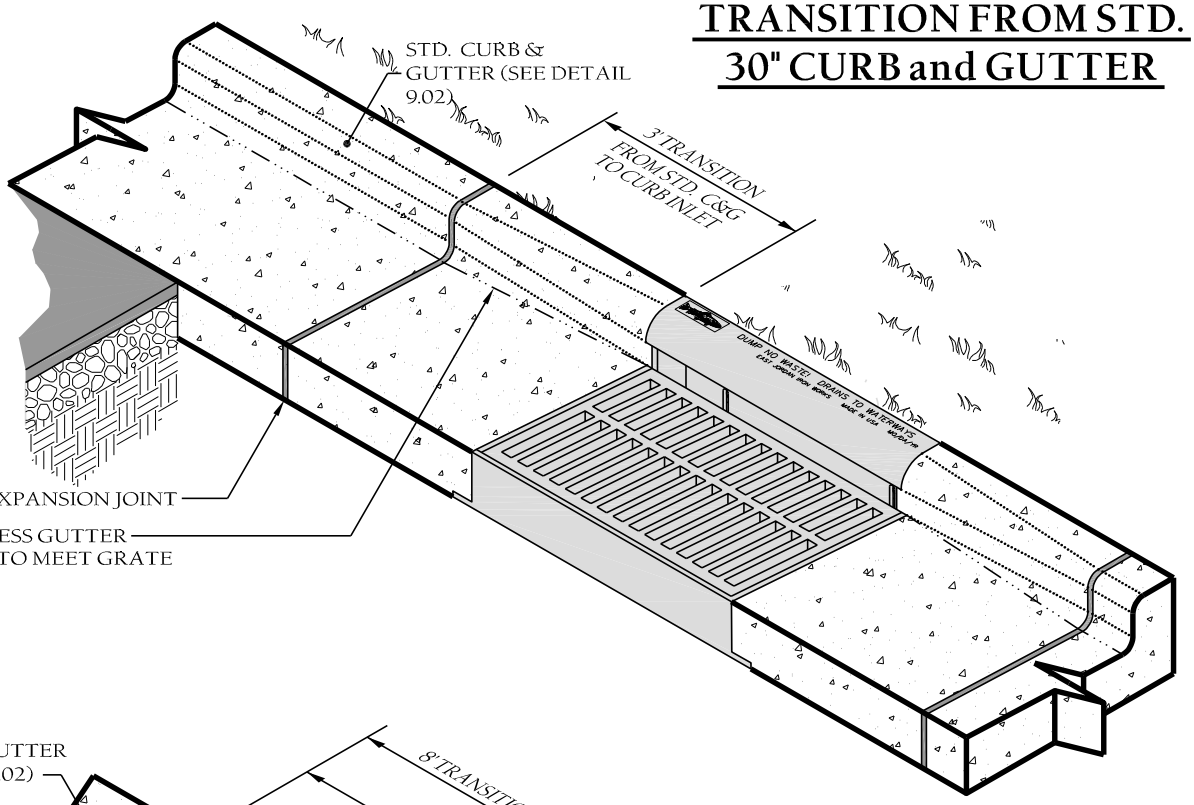
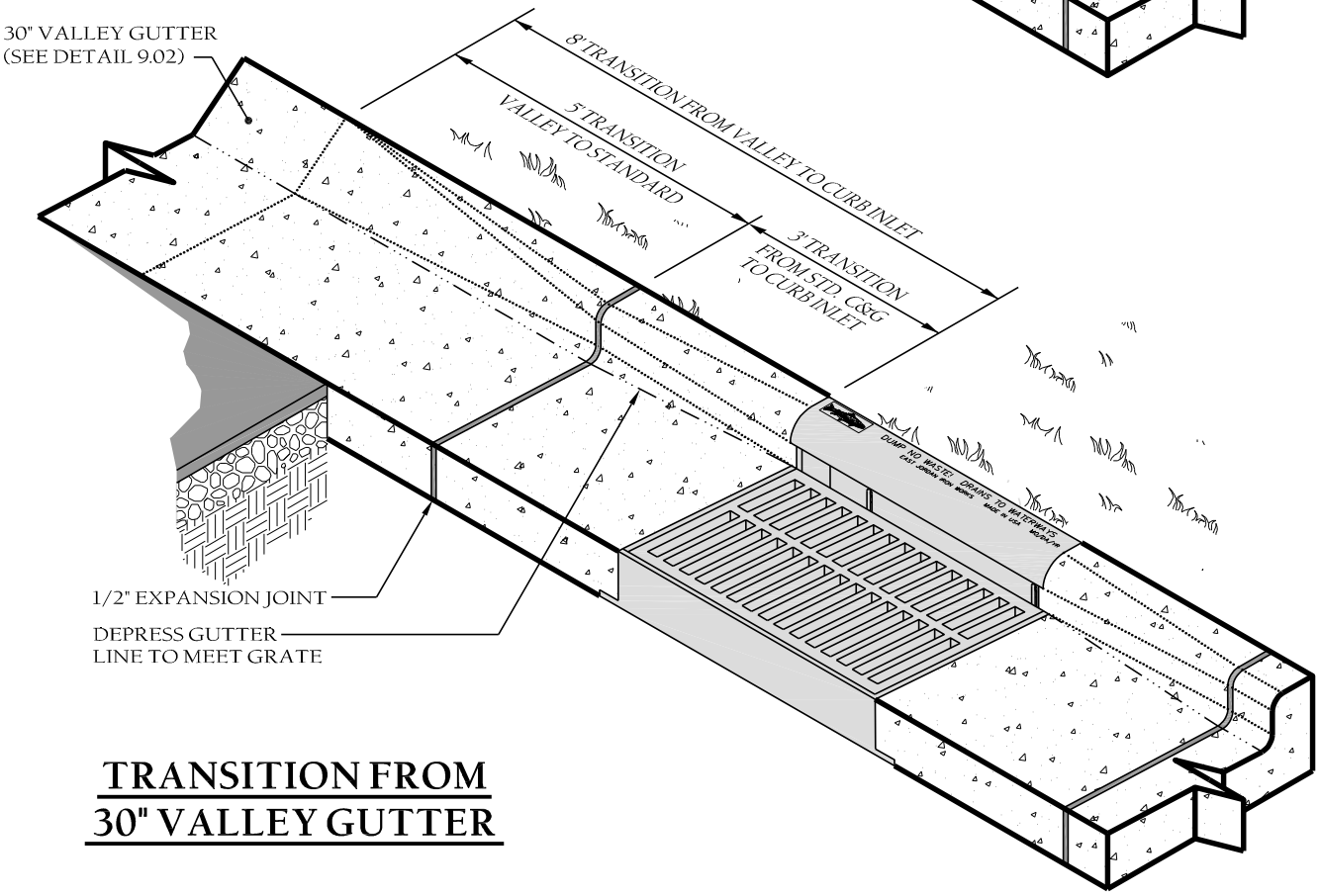
TRANSITION FROM STD. 30" CURB and GUTTER





TRANSITION FROM 30" VALLEY GUTTER

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STD. C&G INLET W/HOOD DETAIL

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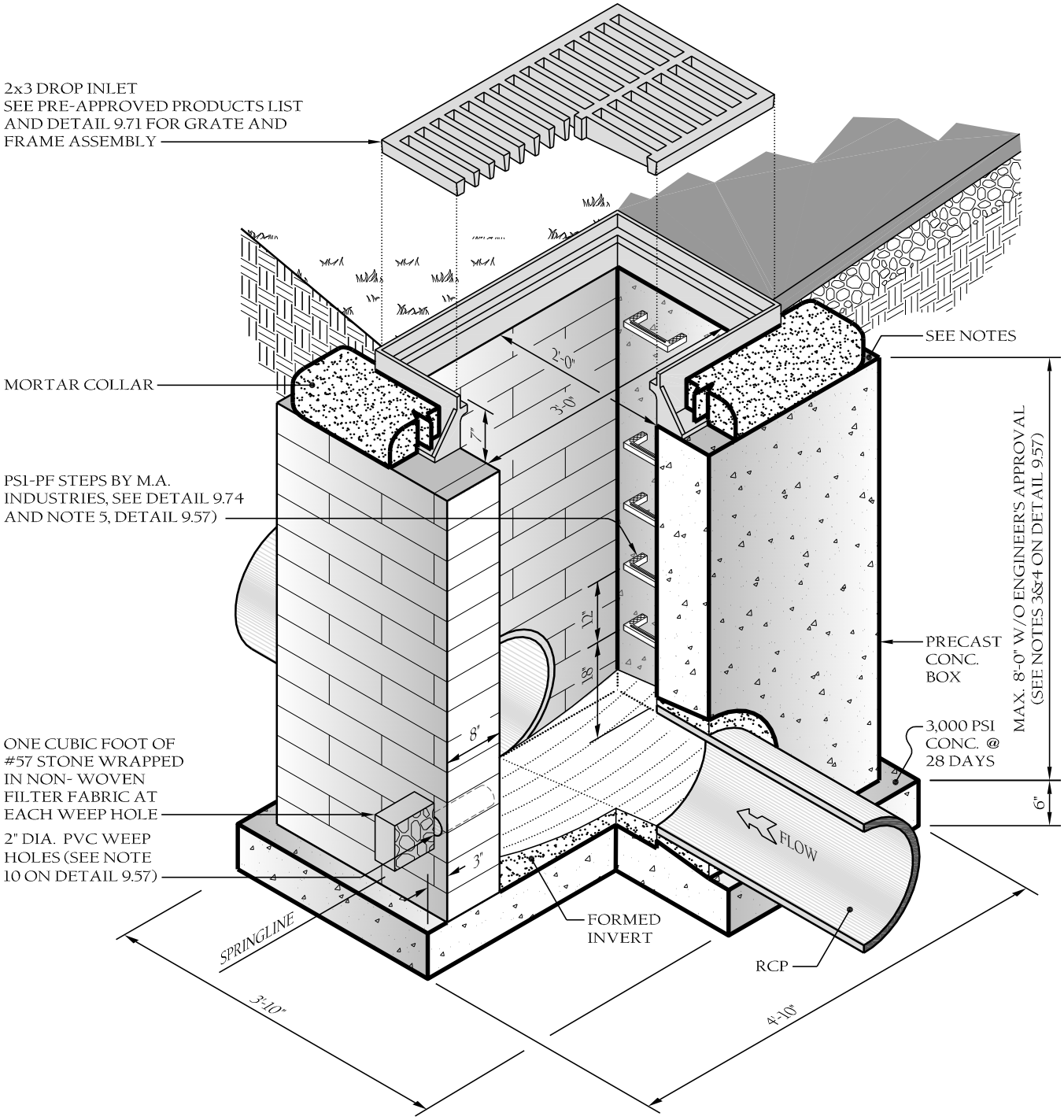

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TOWN of WAKE FOREST

STANDARD 2x3 CATCH BASIN

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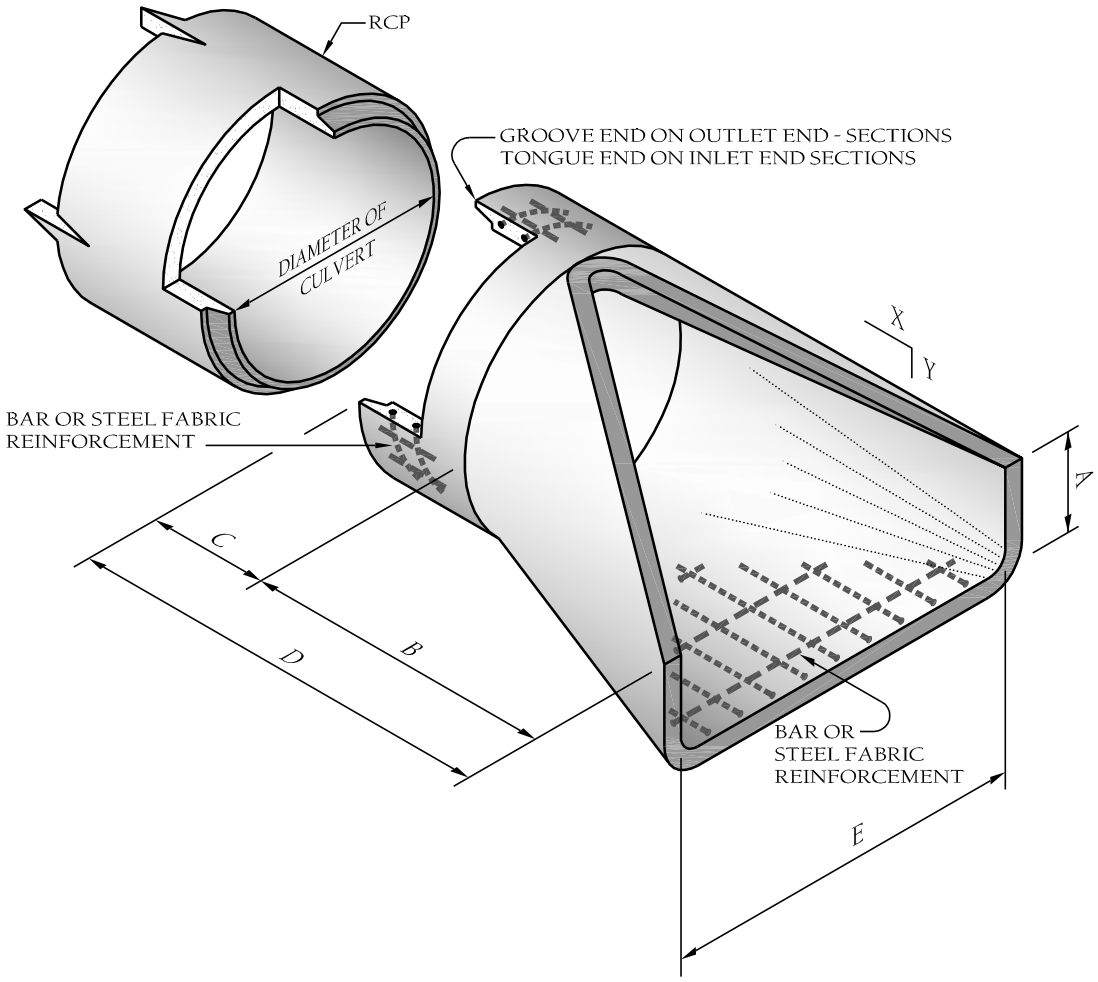
END SECTION DIMENSIONS						
DIA.	A	B	C	D	E	X:Y
15"	6"	2'-3"	3'-10"	6'-1"	2'-8:	2.4:1
18"	9"	2'-3"	3'-10"	6'-1"	3'-0"	2.4:1
24"	10"	3'-8"	2'-6"	6'-2"	4'-0"	2.3:1
30"	1'-0"	4'-6"	1'-8"	6'-2"	5'-0"	2.5:1
36"	1'-3"	5'-3"	2'-11"	8'-2"	6'-0"	2.5:1
42"	1'-9"	5'-3"	2'-11"	8'-2"	6'-6"	2.5:1



NOTES:

1. *Design Of End-section Shall Conform To Standard Reinforced Sectional Concrete Culvert Pipe.*
2. *Any Twin Barrel System Greater Than 42" Rcp Requires a headwall.*
3. *Any System Of More Than 2 Pipes Requires a headwall.*
4. *See NCDOT "Roadway Standard Drawings" for headwall construction details.*
5. *See Erosion & Sedimentation Manual for dissipation pad design requirements.*

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STD. FLARED END SECTIONS DESIGN AID DETAIL

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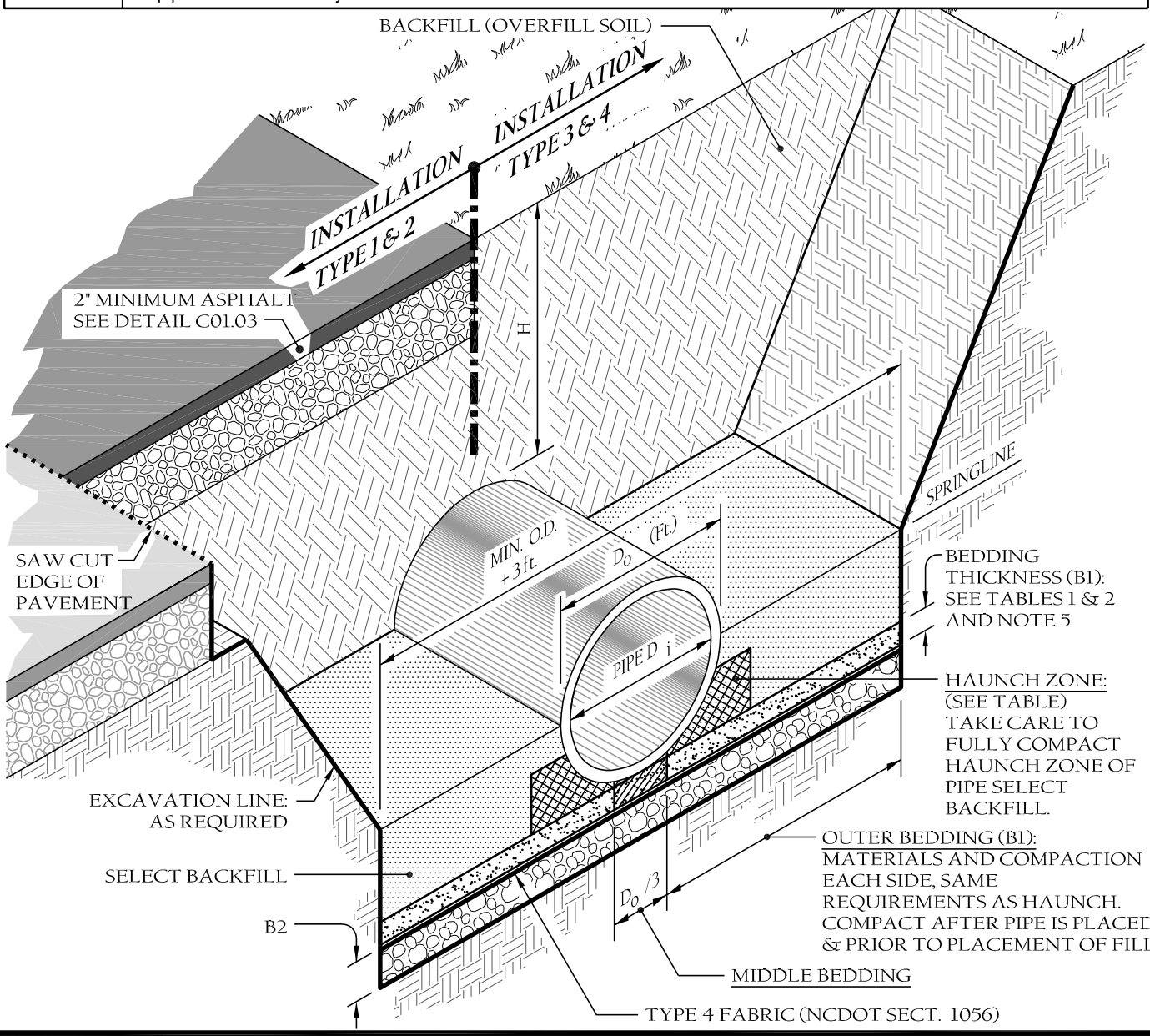
H=	The fill height measured vertically at any point along the pipe from the top of the pipe to the top of the embankment at that point. Do not operate heavy equipment over any pipe culvert until the pipe culvert has been properly backfilled and covered with at least 3 feet of approved material.
	Undisturbed earth material
	Bedding (Middle and Outer): Loosely placed select backfill material meeting NCDOT Class **II**, Type 1 (washed or unwashed crushed stone screenings) or Class **III**, Type 1 (NCDOT 2S or 2MS fine aggregate). Leave section directly beneath pipe uncompacted as pipe seating and backfill will accomplish compaction.
	Select Backfill (Below springline): Select backfill material meeting NCDOT Class **II**, Types 1 or 2 or NCDOT Class **III**, Types 1 or 2.
	Backfill: Approved suitable local compactable material above springline of pipe meeting Town of Wake Forest specifications.
	Rock Foundation or Unsuitable Material Foundation: Select material NCDOT Class V (#78M stone) or NCDOT Class VI (#57 stone) for foundation conditioning. Encapsulate with engineering fabric as directed by the Engineer; Type 4 soil stabilization fabric (NCDOT Table 1056-1). Overlap all transverse and longitudinal joints in fabric at least 18 inches. Maintain the pipe foundation in a dry condition.



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STORM DRAIN PIPE INSTALLATION

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Table 1
Equivalent USCS[a] and AASHTO Soil Classifications for SIDD[b] Soil Designations

SIDD	USCS	NCDOT/AASHTO
Gravelly Sand (Category I)	SW, SP, GW, GP	- NCDOT Class II-Type I (crushed stone screenings), LL < 30; PI ≤ 6. - NCDOT Class III, Type 1 (2S or 2MS), LL < 30; PI ≤ 6.
Sandy Silt (Category II)	GM, SM, Also GC, SC with less than 20% passing #200 sieve	- NCDOT Class II Type 1 (crushed stone screenings) and Class II, Type 2 (AASHTO M145 for A-2-4 with maximum PI of 6, A-4 w/ max 45% passing No. 200 Sieve and a maximum PI of 6) - NCDOT Class III, Type 1 (2S or 2MS) or Class III, Type 2 (AASHTO M145 for soil classification A-1 or A-3)
Silty Clay (Category III)	CL, MH, GC, SC	A5, A6

[a] Unified Soil Classification System
[b] Standard Installations Direct Design

Table 2
Standard Installations Soils and Minimum Compaction Requirements

Installation Type	Bedding Thickness	Outer Bedding (B1) Note 5 (% compaction/Category)	Haunch Zone & Select Backfill Area (% compaction/Category)	Location
Type 1	B1 = Di/6 (6" min) B2 = If Rock foundation or over unsuitable foundation, ½"/ft of 'H', 12" min/24" max	95% Category I	90% Category I, 95% Category II	Paved Areas with 2' or less bury
Type 2	B1 = Di/6 (6" min) B2 = If Rock foundation or over unsuitable foundation, ½"/ft of 'H', 12" min/24" max	90% Category I	85% Category I, 90% Category II	Paved Areas with greater than 2' of bury
Type 3	B1 = Di/6 (6" min) B2 = If Rock foundation or over unsuitable foundation, ½"/ft of 'H', 12" min/24" max	85% Category I 90% Category II	85% Category I, 90% Category II, or 95% Category III	In R/W outside of Pavement
Type 4	B1 = Di/6 (6" min) B2 = If Rock foundation or over unsuitable foundation, ½"/ft of 'H', 12" min/24" max	No Compaction required, except if Category III, use 85% Category III	No Compaction required, except if Category III, use 85% Category III	Natural Areas

NOTES:

1. *Compaction and soil symbols - i.e. "95% Category I" - refers to Category I soil material with minimum standard Proctor compaction of 95%.*
2. *Soil in the outer bedding, haunch, and lower side zones, except under the middle 1/3 of the pipe, shall be compacted to at least the same compaction as the majority of the soil in the overfill (backfill) zone.*
3. *For trenches, the top elevation shall be no lower than 0.1H below finished grade or, for roadways, its top shall be no lower than an elevation of 1-foot below the bottom of the pavement base material.*
4. *For trenches, the width shall be wider than shown if required for adequate space to attain the specified compaction in the haunch and bedding zones.*
5. *Compact outer bedding after pipe is placed and prior to placement of select fill. Middle bedding is uncompacted.*
6. *Overfill (Backfill) soils to be placed per standard specification 02700 Storm Drainage for the applicable backfill type and bury limitations.*
7. *These two tables were excerpted from Design Data 9 and modified to generally conform to the NCDOT Standards as shown in Detail 300.01, Rigid Pipe in Trench Condition.*

Reference Sources:

1. *ACPA Design Data 9 [April, 2009] (formerly Design Data 40).*
2. *2012 NCDOT Standard Specifications for Roads and Structures and NCDOT Standard Details 300.01 for Rigid Pipe, "Trench Condition."*

Fill Height Table[a]				
	Type 3 (Bedding) Installation (0.01 Inch Crack)		Type 4 (Bedding) Installation (0.01 Inch Crack)	
Inside Pipe Diameter D_i (inches)	Class III Pipe Maximum Bury H (feet)	Class IV Pipe Maximum Bury H (feet)	Class III Pipe Maximum Bury H (feet)	Class IV Pipe Maximum Bury H (feet)
15	2 min, 12 max	1 min, 20 max	3 min, 7 max	2 min, 12 max
18	2 min, 12 max	1 min, 20 max	3 min, 7 max	1 min, 13 max
24	1 min, 12 max	1 min, 20 max	2 min, 8 max	1 min, 13 max
30	1 min, 12 max	1 min, 20 max	1 min, 8 max	1 min, 13 max
36	1 min, 12 max	1 min, 20 max	1 min, 8 max	1 min, 13 max
42	1 min, 12 max	1 min, 20 max	1 min, 8 max	1 min, 13 max
48	1 min, 12 max	1 min, 19 max	1 min, 8 max	1 min, 13 max
54	1 min, 12 max	1 min, 19 max	1 min, 8 max	1 min, 13 max
60	1 min, 12 max	1 min, 19 max	1 min, 8 max	1 min, 13 max
72	1 min, 11 max	1 min, 19 max	1 min, 7 max	1 min, 13 max

Fill Height Tables Based On:

1. Ys= 120 pcf (backfill load)
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition (this gives conservative results in comparison to trench conditions).
4. Pipe = Reinforced Concrete Pipe meeting ASTM C76 (AASHTO M170), wall C thickness.
5. Concrete pipe should be installed in accordance with AASHTO LRFD Bridge Construction Specifications, Section 27 or ASTM C1479.

[a]Fill Height Tables, the portion excerpted here, was developed by the American Concrete Pipe Association (ACPA) using the indirect design method in accordance with Section 12.10.4.3 of the AASHTO LRFD Bridge Design Specification, 4th Edition, 2007 with 2008 Interim.

NOTES:

1. *Greater bury depths than those shown above are achievable by either using Type 1 or 2 Installation, using Class V pipe, controlling backfill type, calculating depth using a trench condition, or by Special Design. See also Design Data 9 published by the ACPA for design methodology.*
2. *In lieu of calculating bury depth for other conditions, first see "LRFD Fill Height Tables for Concrete Pipe", last revised July 2009 (or later), prepared by the ACPA for other bury depth possibilities.*

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STORM DRAIN PIPE INSTALLATION

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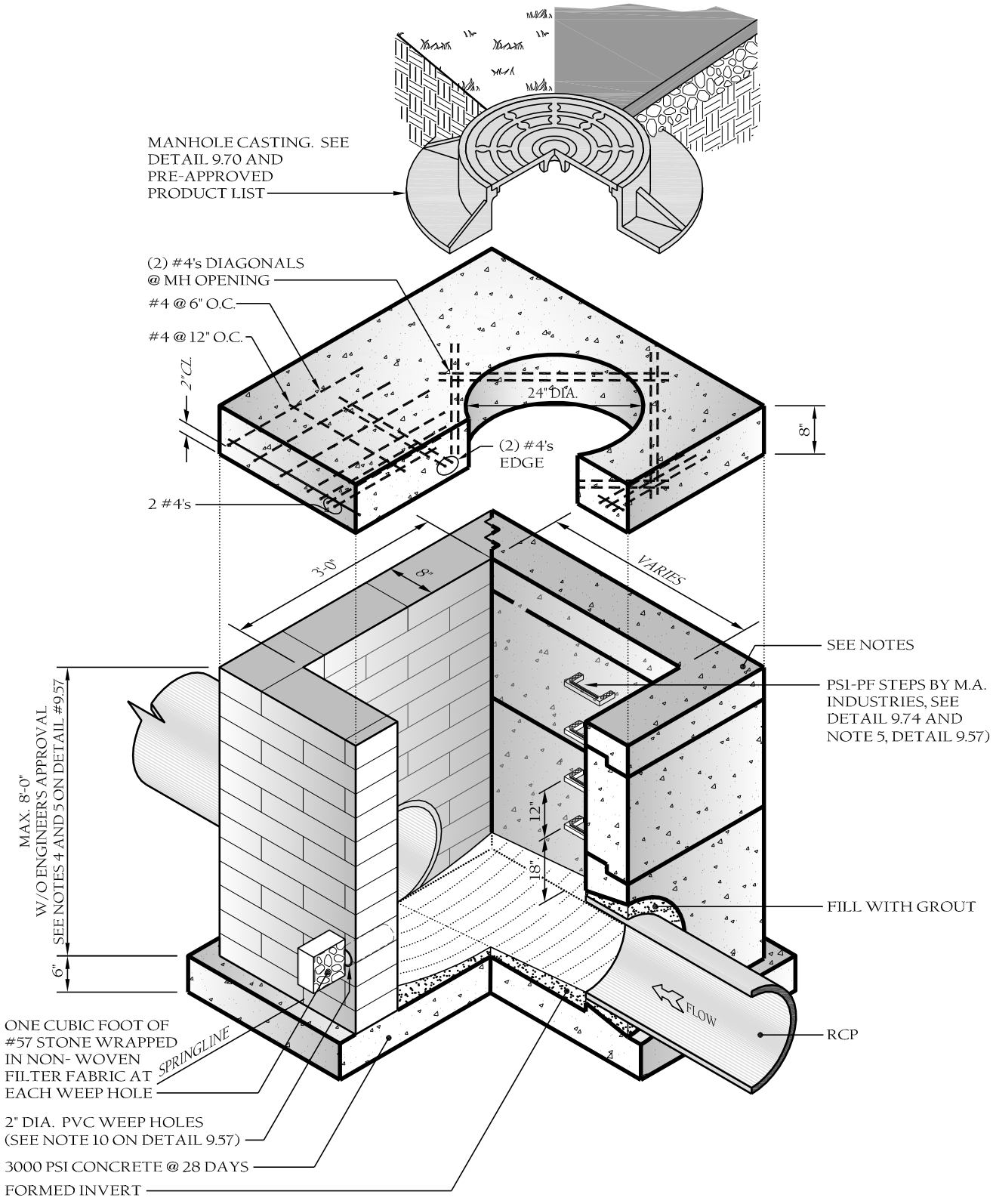

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STD. M.H. J.B. VARIABLE LENGTH

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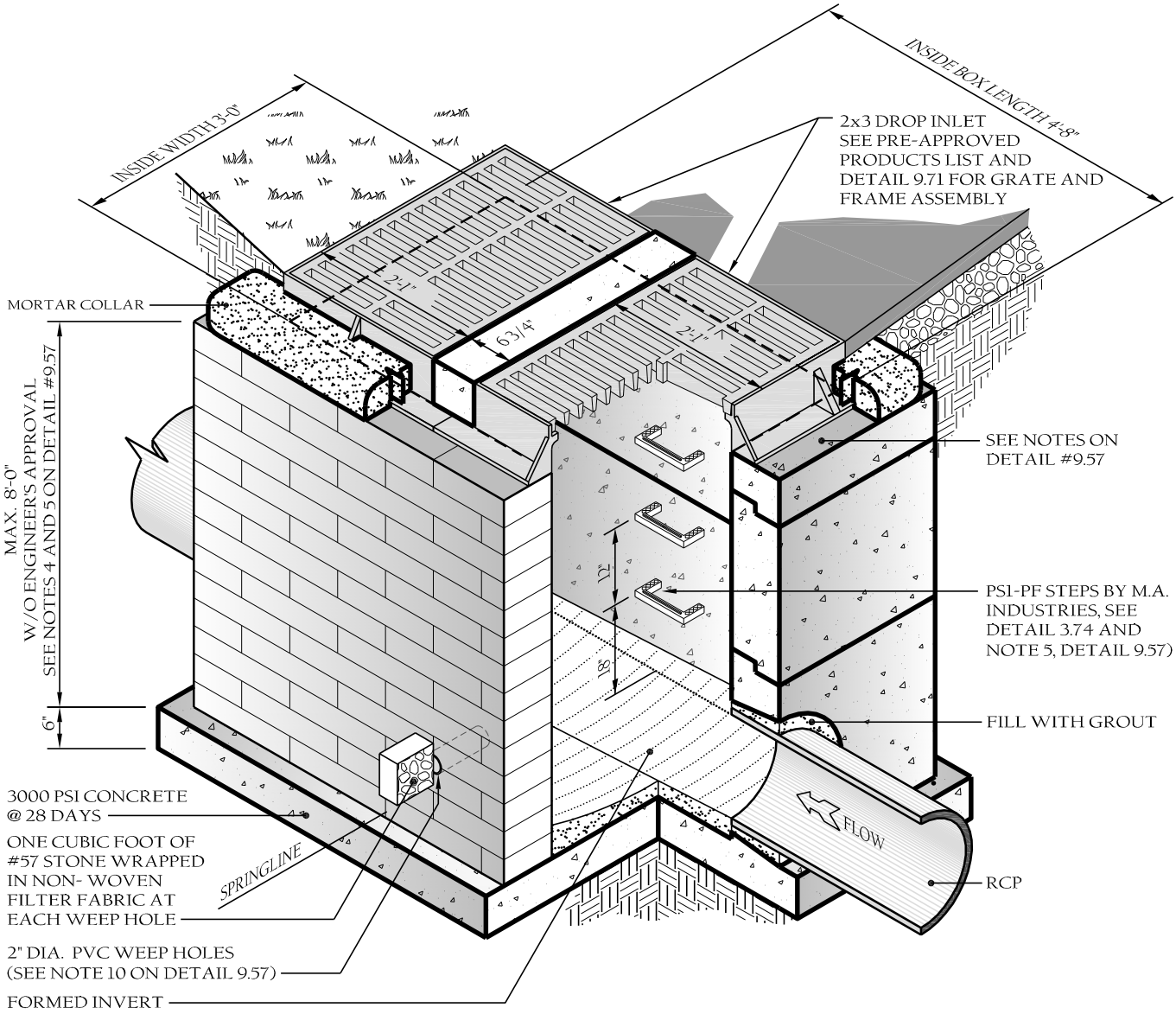

TOWN of WAKE FOREST

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STD. MULTIPLE 2' x 3' CATCH BASIN DETAIL

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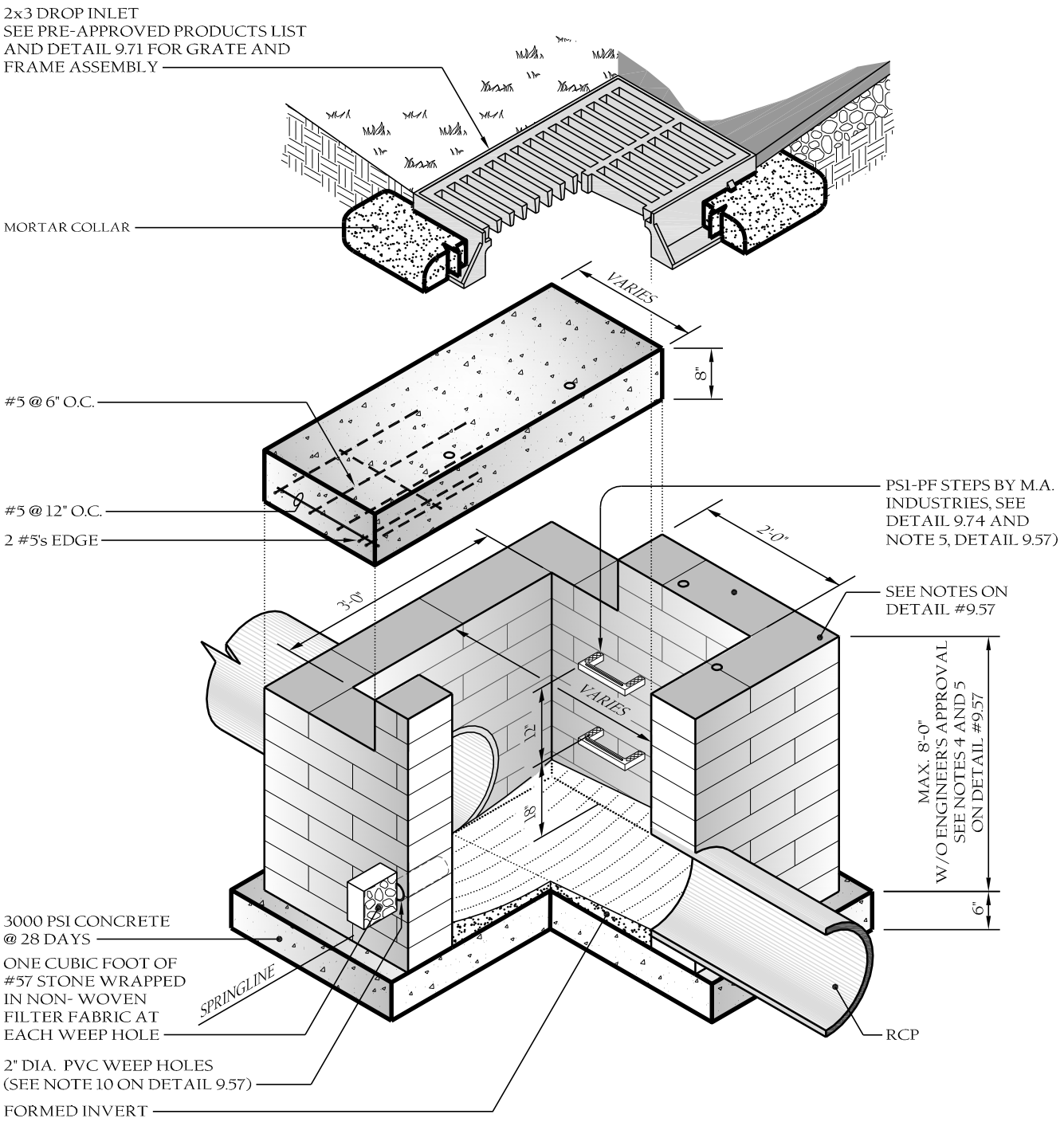

TOWN of WAKE FOREST

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STD. 3' x VARIABLE LENGTH BRICK BOX WITH 2' x 3' CATCH BASIN

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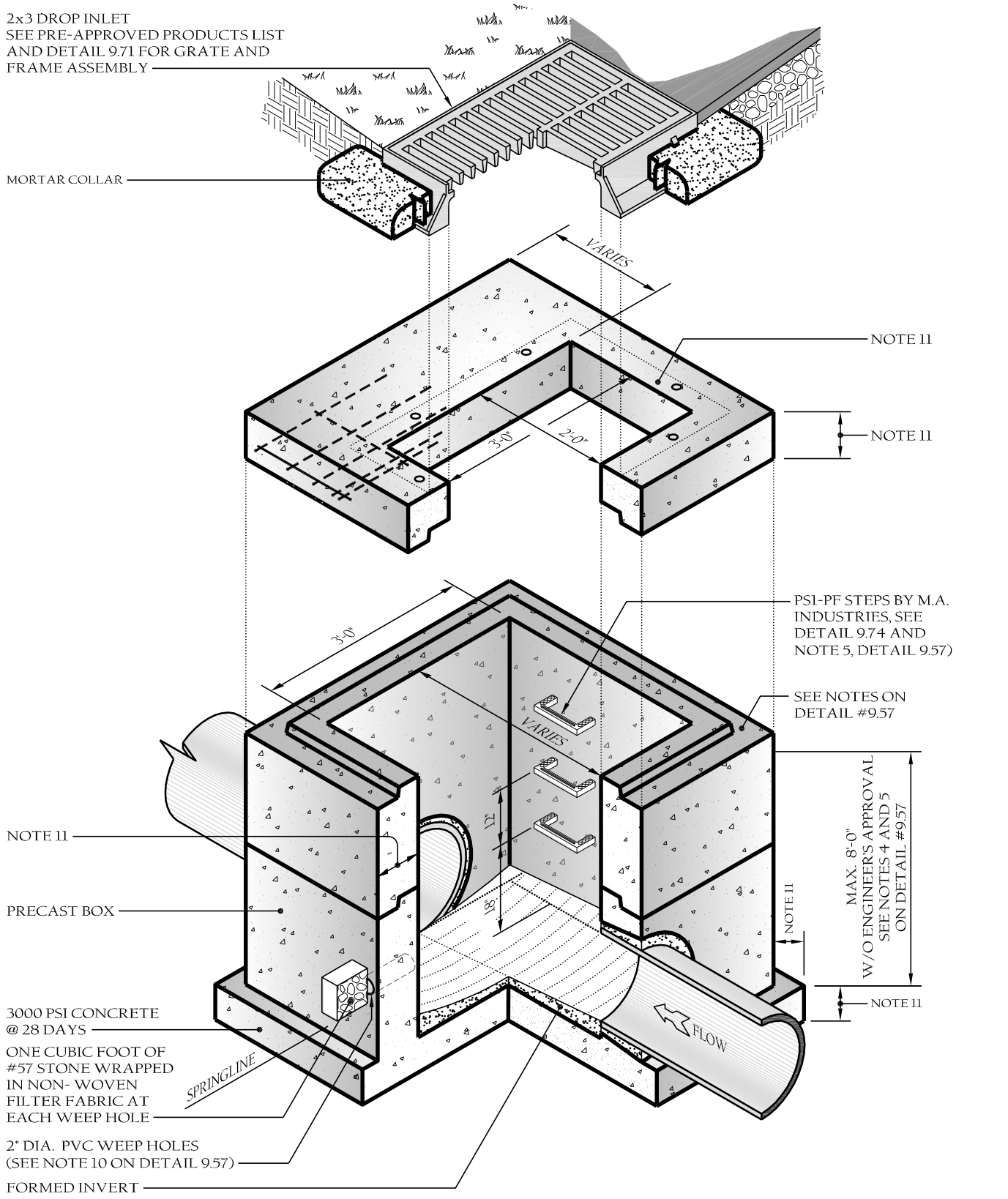

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STD. 3' x VARIABLE LENGTH PRECAST BOX WITH 2' x 3' CATCH BASIN

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Notes:

Drainage Structures Notes.

1. *Boxes may be reinforced masonry, masonry, precast concrete or cast-in-place reinforced concrete.*
2. *Any non-standard box (non-standard meaning not shown in this manual), is to be designed by a NC Professional Engineer.*
3. *The maximum height of an unreinforced masonry drainage structure with 8" walls shall be limited to 8'-0" from invert of the outlet pipe to the top of the iron casting. Depths greater than 8'-0" shall have walls 12" thick. Basins over 12' in total depth shall be designed by a NC Professional Engineer. Four inch walls are not allowed on drainage structures. Bottom slab on structures shall be reinforced when box depth exceeds 8 ft. The maximum horizontal span of an unreinforced brick/block box at 8' deep without engineering, = 5'-0" clear (K_0=0.66, EFP=65 psf silty/clayey sand).*
4. *Steps are to be provided on all basins deeper than 42".*
5. *Steps are to be PS1-PF as manufactured by M. A. Industries or an approved equal. Locate on non-pipe walls. See detail 9.74.*
6. *Mortar in masonry boxes is to be type M.*
7. *Clay brick structures are not allowed.*
8. *Concrete pipe is to be minimum class III.*
9. *Concrete building brick is to meet ASTM C-90 for Type II. Solid concrete block to be used in lieu of clay brick for minor drainage structure and manholes to meet ASTM C139.*
10. *Basin located in wet areas, or as otherwise required by the town engineer, shall have weep holes as shown on details.*
11. *All cast-in-place or precast concrete drainage structures located in paved areas accessible to truck loadings to be designed to meet AASHTO HS 20-44 loading. See manufacturers details for wall, top and bottom thickness.*
12. *Place minimum 6" #57 stone bedding beneath precast structures.*

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RESERVED
FUTURE DETAIL

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RESERVED FUTURE DETAIL

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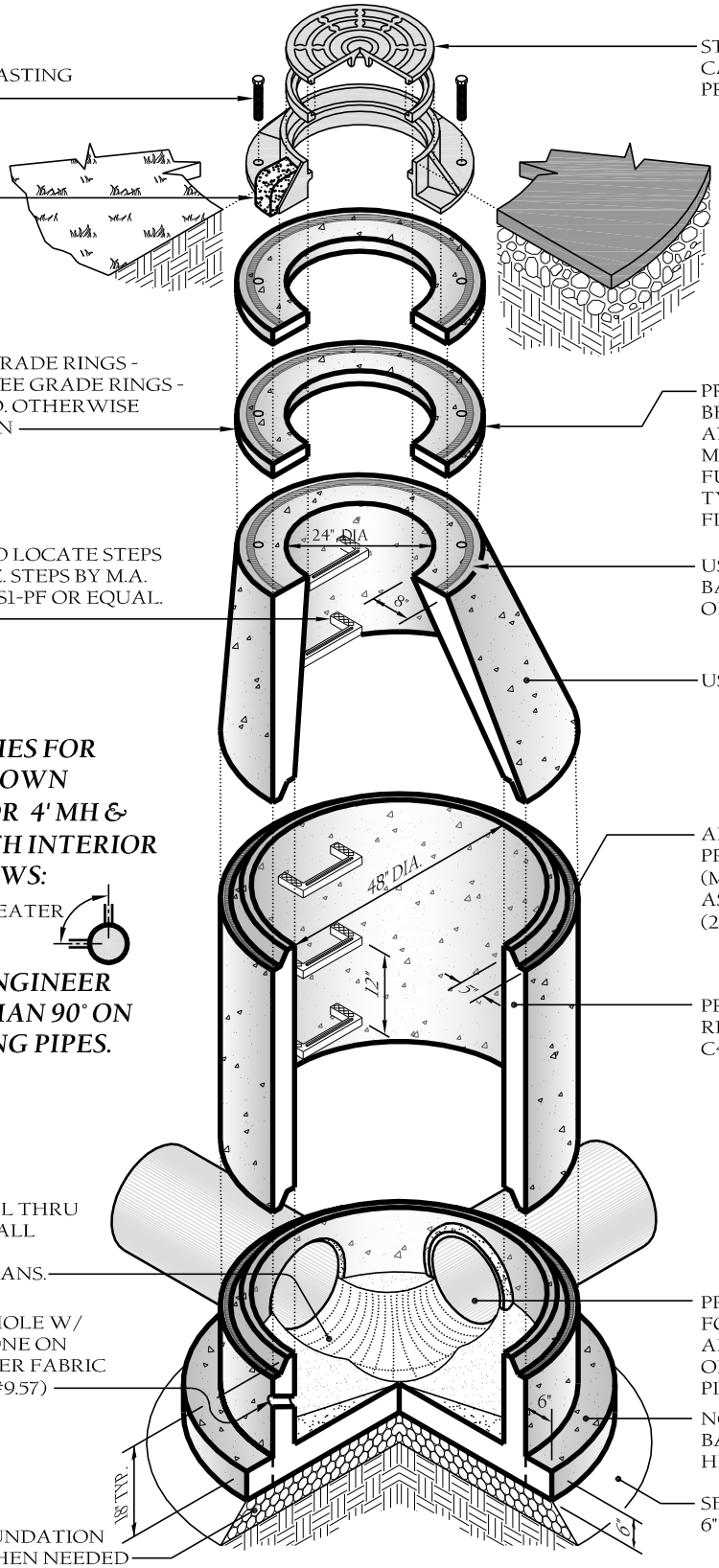

NOTE:

THIS DETAIL APPLIES FOR LARGEST PIPES SHOWN BELOW (I.E.: 30" FOR 4' MH & 42" FOR 5' MH) WITH INTERIOR ANGLES AS FOLLOWS:

90° OR GREATER

CONSULT WITH ENGINEER IF ANGLES LESS THAN 90° ON TWO INTERSECTING PIPES. SEE DETAIL 9.75.

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PRECAST CONCRETE 4' DIA. MH JB

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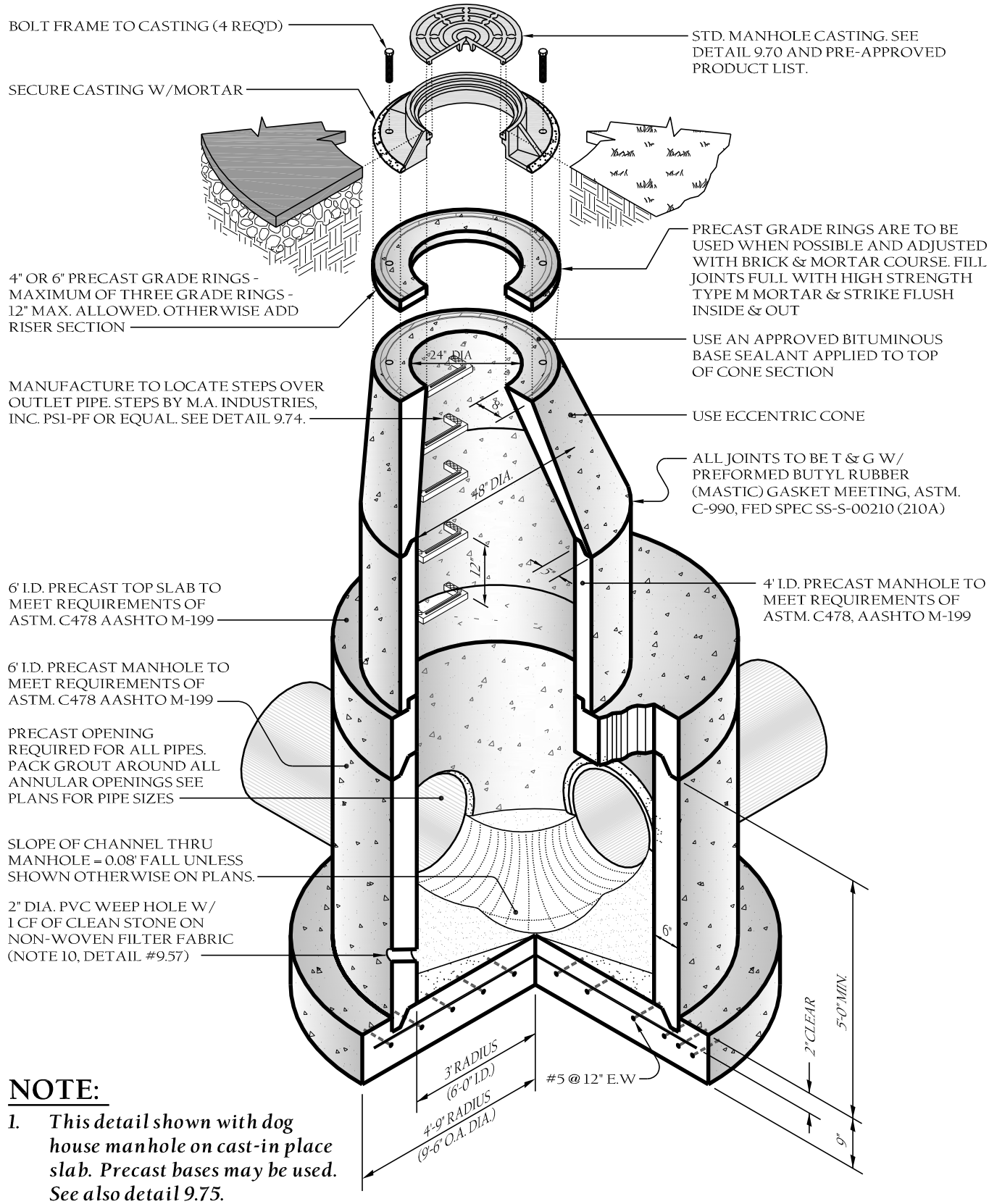

NOTE:

1. *This detail shown with dog house manhole on cast-in place slab. Precast bases may be used. See also detail 9.75.*

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PRECAST CONCRETE 6' TO 4' DIA. MH JB

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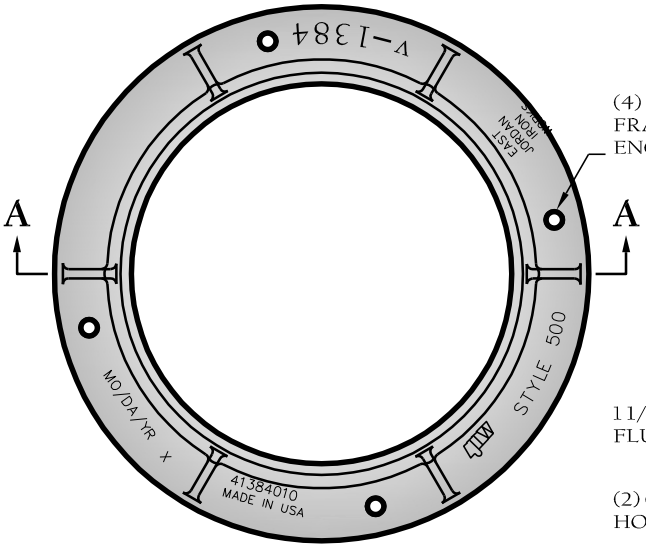
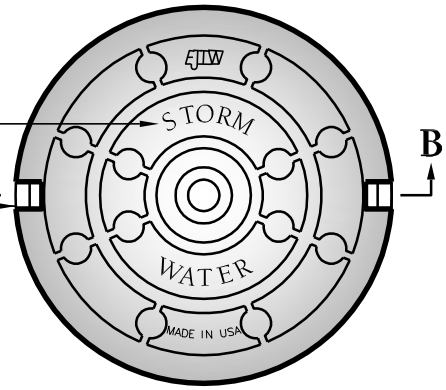


(4) 1" DIA. ANCHOR BOLT. HOLES EQUALLY SPACED. BOLT FRAME TO CONE SECTION WHEN ORDERED BY CITY ENGINEER OR WATER RESOURCES.

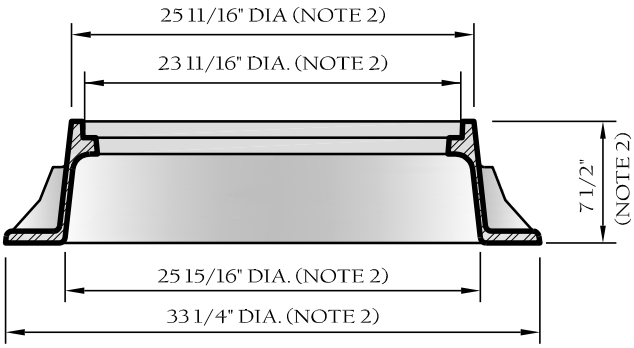
FRAME TOP

1 1/4" LETTERS (RECESSED FLUSH

(2) CLOSED PICK HOLES

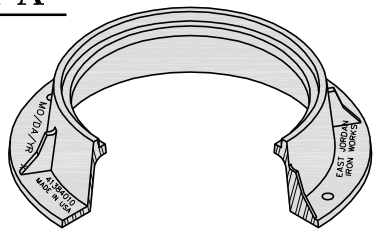


COVER FACE

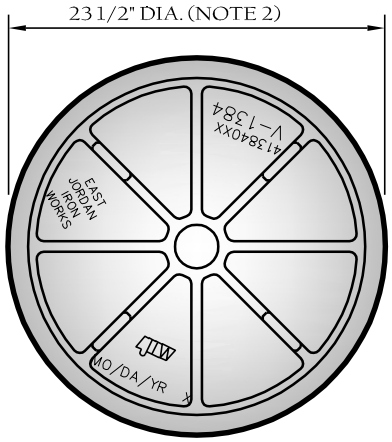


FRAME SECTION A-A

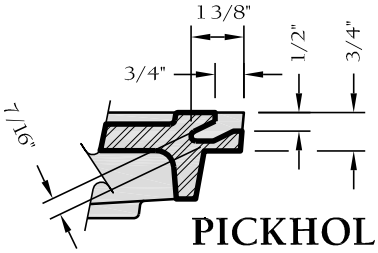
COVER SECTION B-B



ISOMETRICS



COVER BACK



PICKHOLE

APPROVED MODELS	EAST JORDON V-1384 *
COVER WEIGHT	128 Lbs.
FRAME WEIGHT	153 Lbs.
LOAD RATING	HEAVY DUTY
MATERIAL	ASTM A 48 CLASS 35B
FINISH	UN COATED

* EJIW OR APPROVED EQUAL
SEE PRE-APPROVED PRODUCTS LIST

NOTES:

1. *Frame & Cover weight may not deviate by more than -5.0%.*
2. *Iron casting to comply with AASHTO M306.*

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STANDARD MANHOLE CASTING STORM DRAINAGE STRUCTURES

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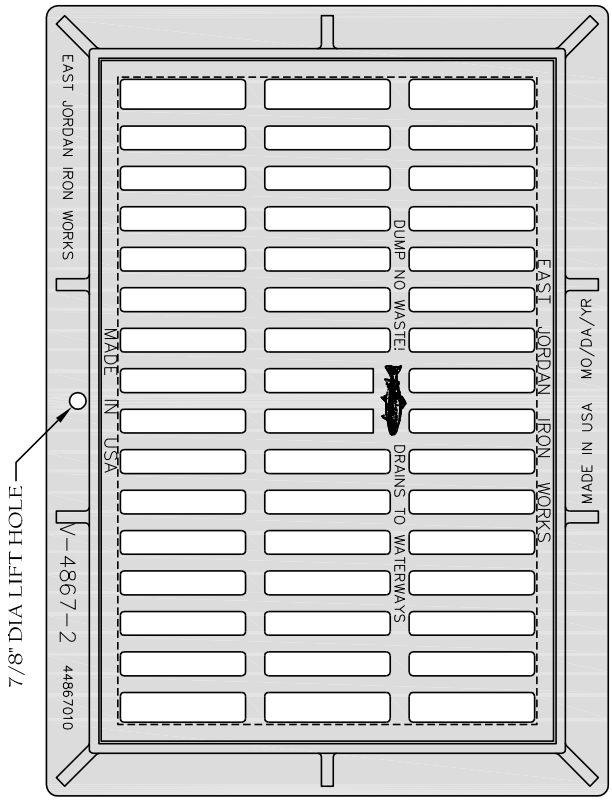
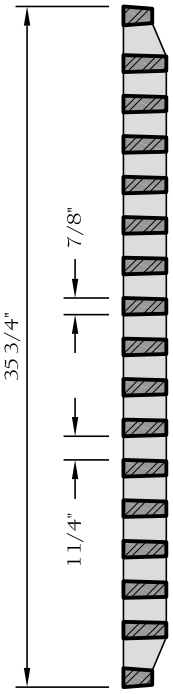
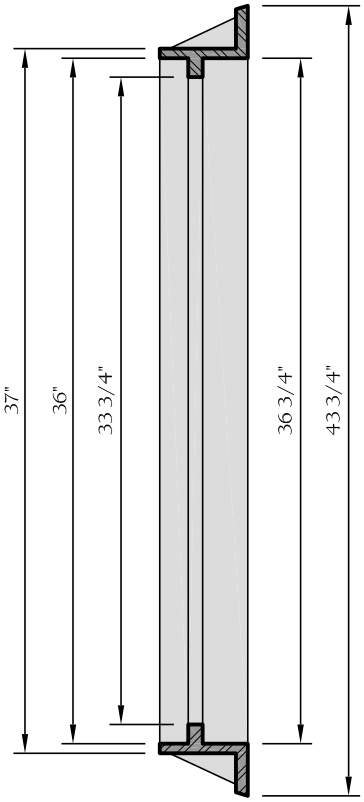




GRATE



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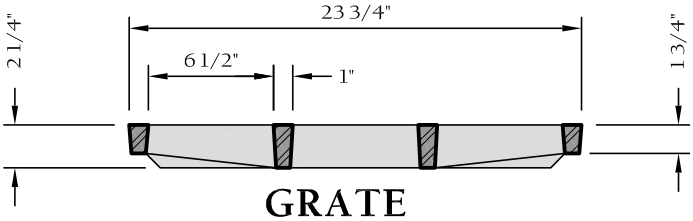
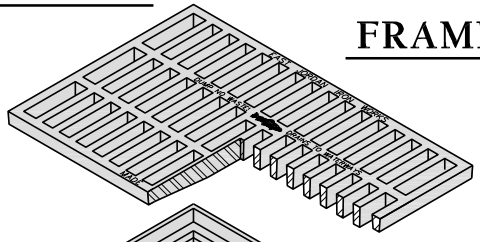


GRATE



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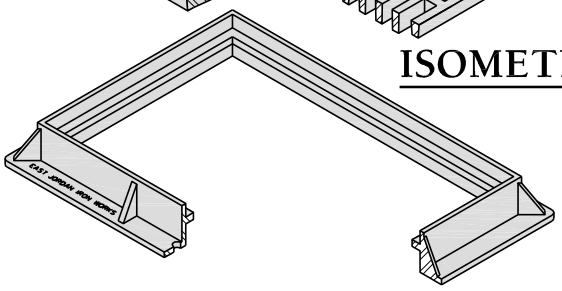

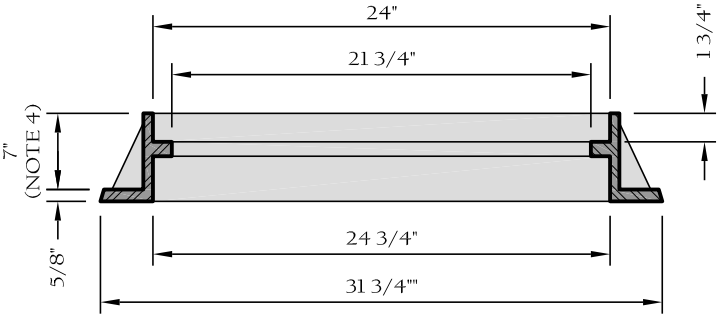

FRAME

APPROVED MODELS	EAST JORDON V-4867-2 *
GRATE WEIGHT	190 Lbs.
FRAME WEIGHT	159 Lbs.
LOAD RATING	HEAVY DUTY
MATERIAL	ASTM A 48 CLASS 35B
FINISH	UNDIPPED

* EJIW OR APPROVED EQUAL. SEE PRE-APPROVED PRODUCT LIST

NOTES:

1. *Frame & Cover weight may not deviate by more than -5.0%.*
2. *Iron casting to comply with AASHTO M306.*
3. *Net open area = 390 Sq. In.*
4. *For a 4" high frame, Use EJIW V-5660 or approved equal.*

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STANDARD CATCH BASIN ASSEMBLY FRAME & GRATE

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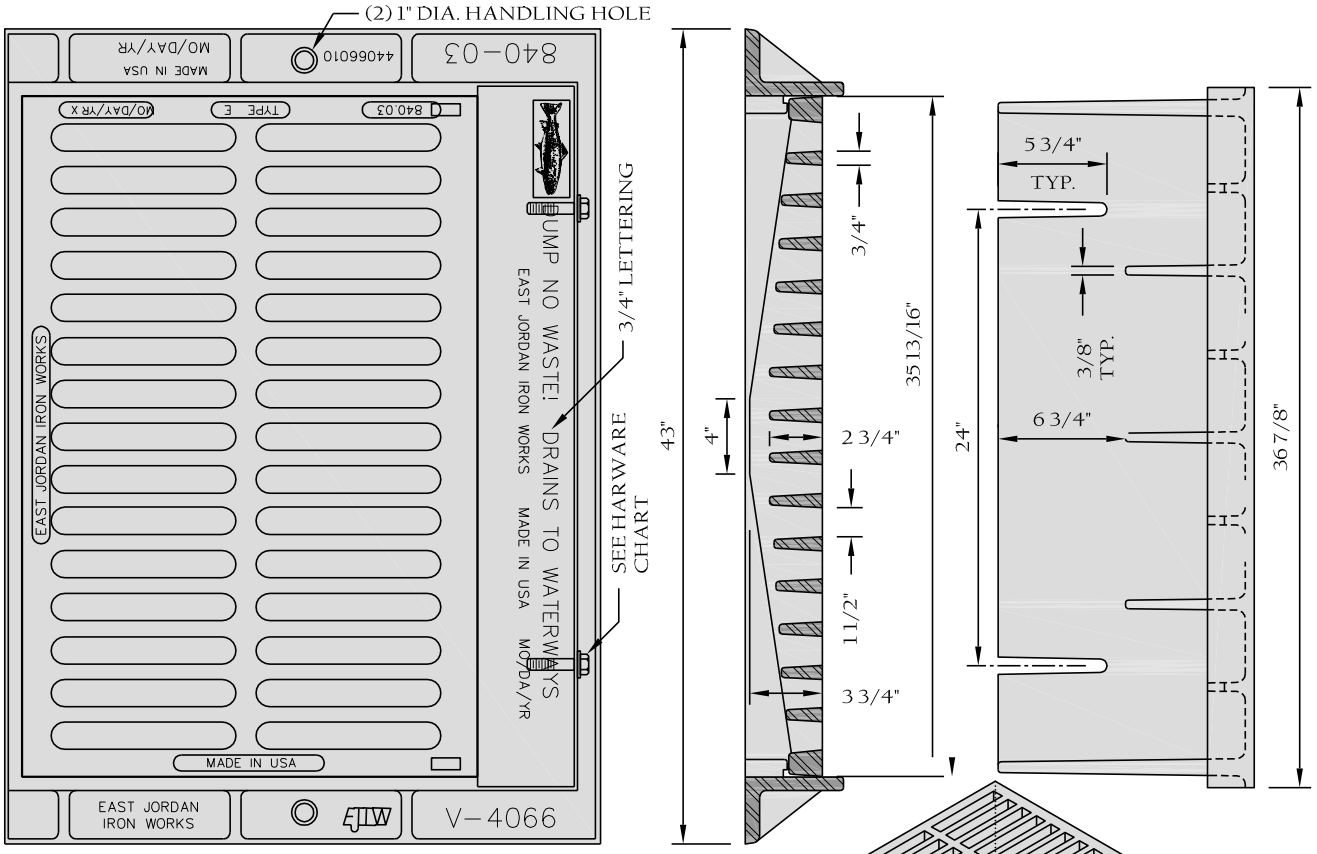
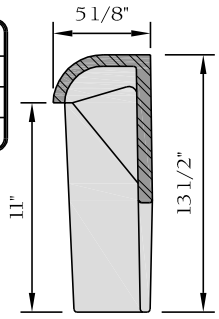
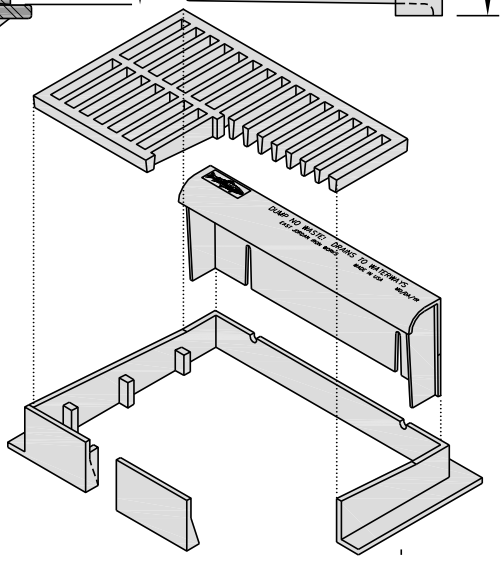
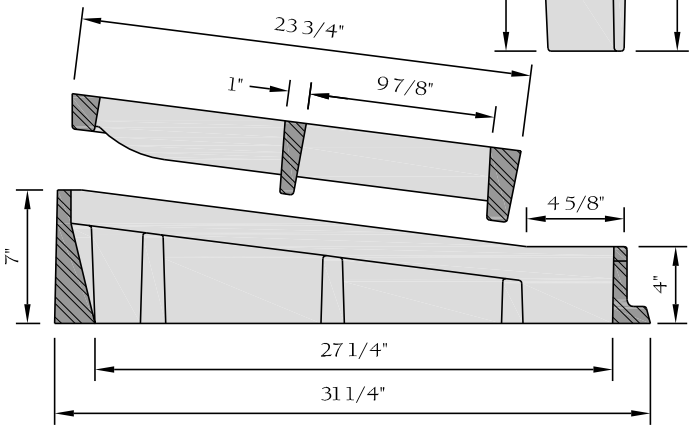


HARDWARE CHART:
(2) 00981234 BLT HX 5/8-11x2.5 ZN2
(2) 00981290 NUT HX 5/8-11 ZN
(4) 00981291 WSHR 5/8 ID 1.75 OD ZN







APPROVED MODELS	EAST JORDON V-4066-1 *
GRATE WEIGHT	218 Lbs.
FRAME WEIGHT	215 Lbs.
BACK WEIGHT	140 Lbs.
LOAD RATING	HEAVY DUTY
MATERIAL	ASTM A 48 CLASS 35B
FINISH	UNDIPPED

* EJIW OR APPROVED EQUAL. SEE PRE-APPROVED PRODUCT LIST.

NOTES:

1. *Frame & Cover weight may not deviate by more than -5.0%.*
2. *Iron casting to comply with AASHTO M306.*

TOWN of WAKE FOREST

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STANDARD COMBINATION FRAME, HOOD & GRATE (NCDOT 840.03)

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RESERVED
FUTURE DETAIL

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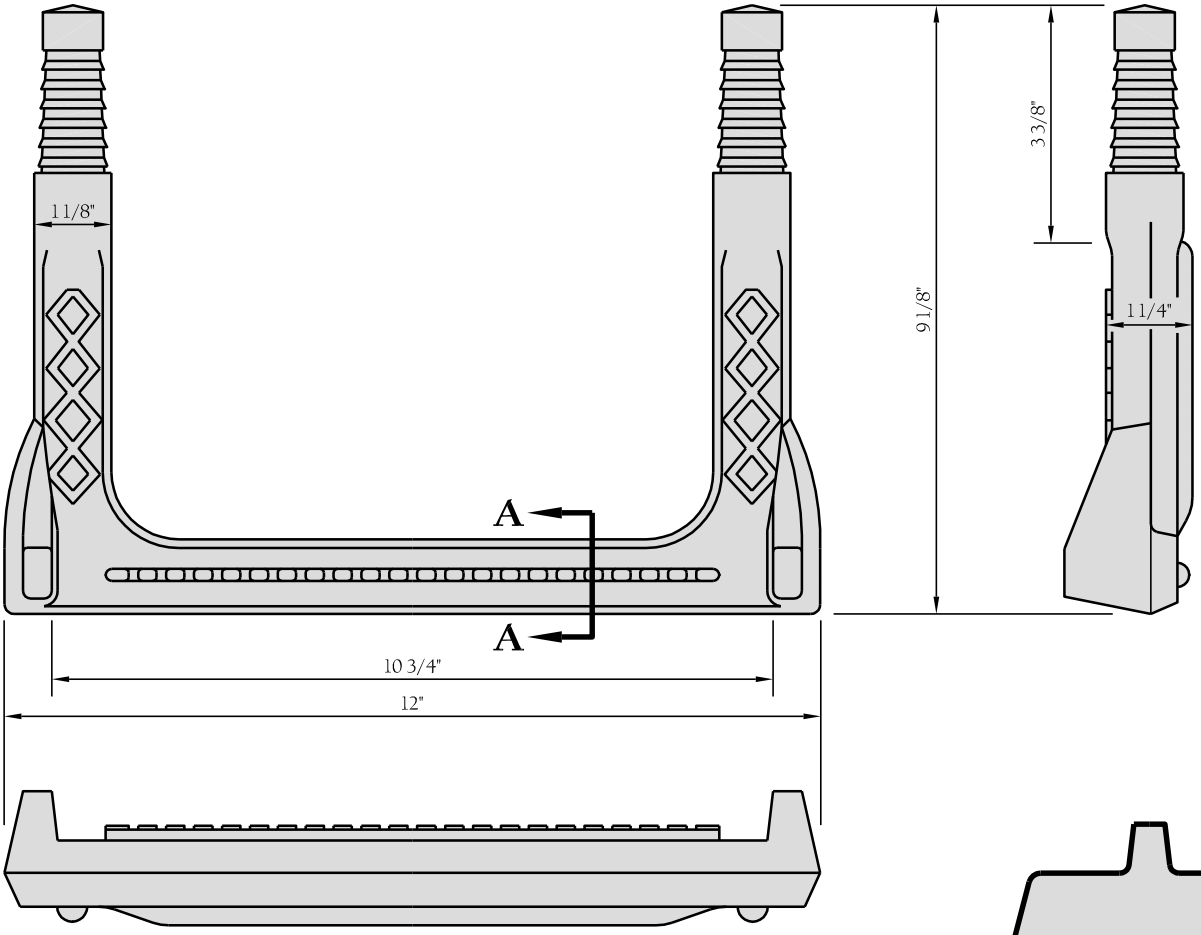
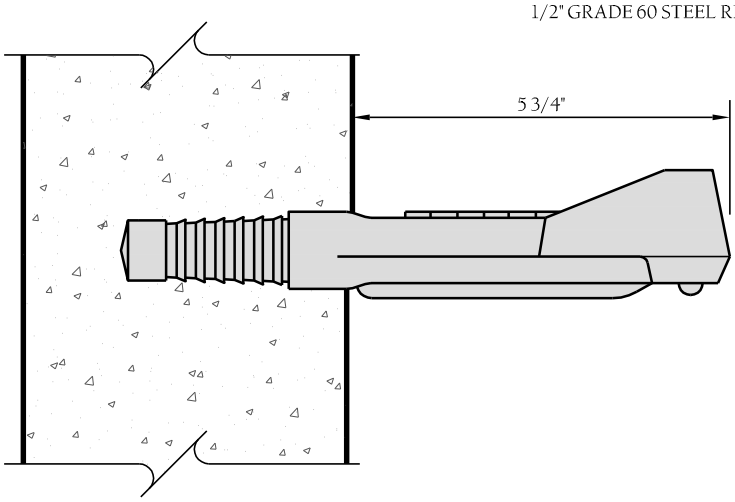
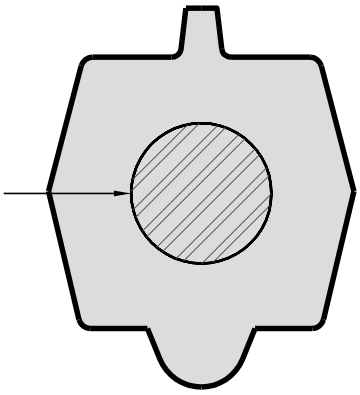


COPOLYMER POLYPROPYLENE PLASTIC
1/2" GRADE 60 STEEL REINFORCEMENT





SECTION A-A

NOTES:

1. *Step shown is PS1-PF BY M.A. Industries Inc. Peachtree City, GA. Alternate may be used if approved by town.*

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MANHOLE STEP DETAIL

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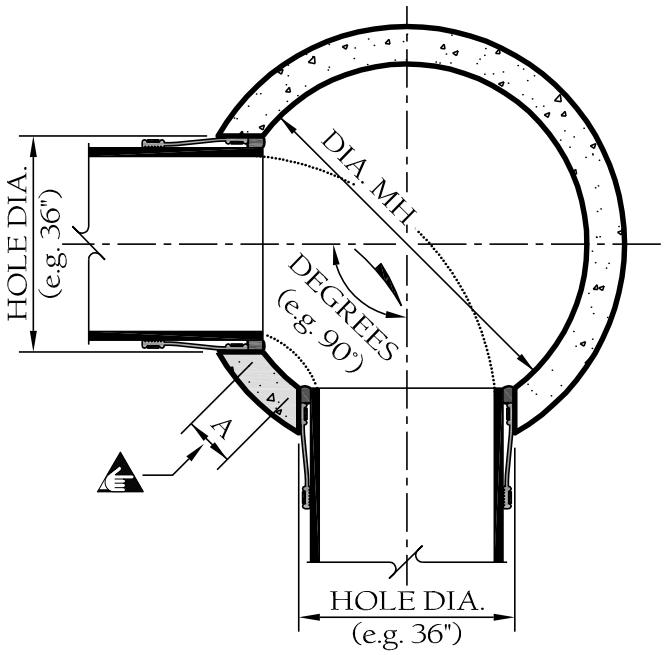
To calculate the closest possible distance between two holes (openings) on the same horizontal centerline, use the following formula:

A = Distance between holes (in degrees)
B = Angle between centerline of pipes
C = Degrees for hole number one from chart below
D = Degrees for hole number two from chart below



If A < 0, the openings are overlapping
If A > 0, A = the distance between holes (in degrees)

4' DIA:

A = 90 - 1/2(95+95) = 90 - 95 = -5, *Holes too close*

5' DIA:

A = 90 - 1/2(75+75) = 90 - 75 = 15, *O.K. for 5' dia.*

There are 15° of angle between holes which is 7 7/8".

4' Dia. MH	
Hole Dia.	Degrees
12"	28°
12"	28°
18"	45°
24"	60°
30"	76°
36"	95°

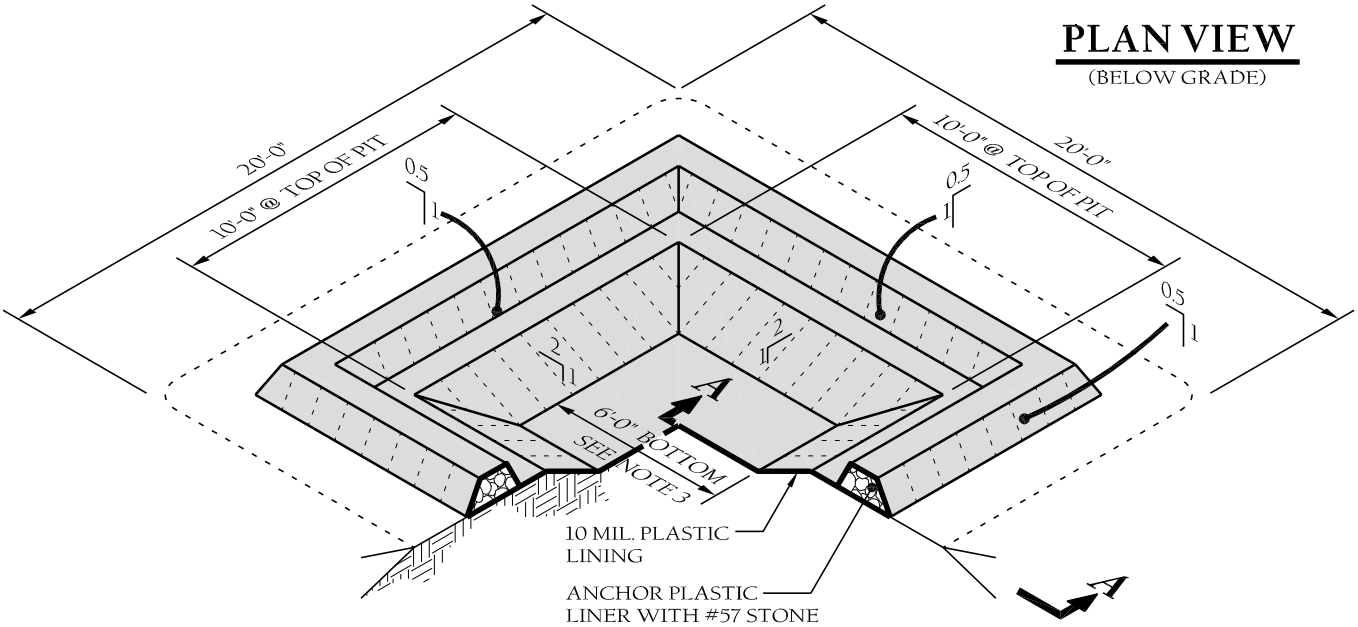
5' Dia. MH	
Hole Dia.	Degrees
12"	22°
18"	35°
24"	48°
30"	62.6°
36"	75°
40"	82°
48"	108°

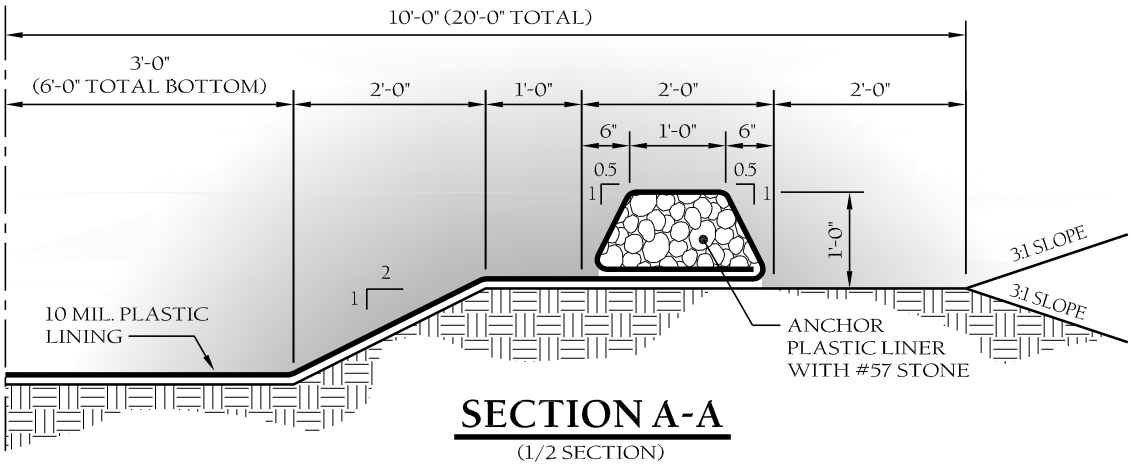
6' Dia. MH	
Hole Dia.	Degrees
12"	20°
16"	25°
20"	32°
24"	38°
36"	60°
40"	65°
43"	70°
48"	84°
55"	98°
63"	125°

8' Dia. MH	
Hole Dia.	Degrees
12"	15°
18"	22°
24"	28°
36"	44°
40"	48°
42"	52°
48"	60°
55"	68°
60"	80°
70"	90°
78"	108°

10' Dia. MH	
Hole Dia.	Degrees
12"	12°
18"	18°
24"	24°
36"	36°
40"	38°
48"	46°
55"	55°
62"	62°
70"	70°
78"	80°

PLAN VIEW
(BELOW GRADE)





SECTION A-A
(1/2 SECTION)

EXCAVATED PIT WITH STONE SUPPORT
NOT TO SCALE

STONE SUPPORT NOTES:

1. Actual layout to be determined in field.
2. The "concrete washout" sign shall be installed within 30 ft of the temporary concrete washout facility.
3. Pit capacity is minimum of 6 cu ft per 10 cu yd of concrete.
4. Contractor to coordinate with usage contracting officer for proper disposal of concrete.

TOWN of WAKE FOREST

TOWN of WAKE FOREST, NC
Manual of Specifications, Standards and Design

CONCRETE WASHOUT PIT DETAIL

Scale:	Detail #:
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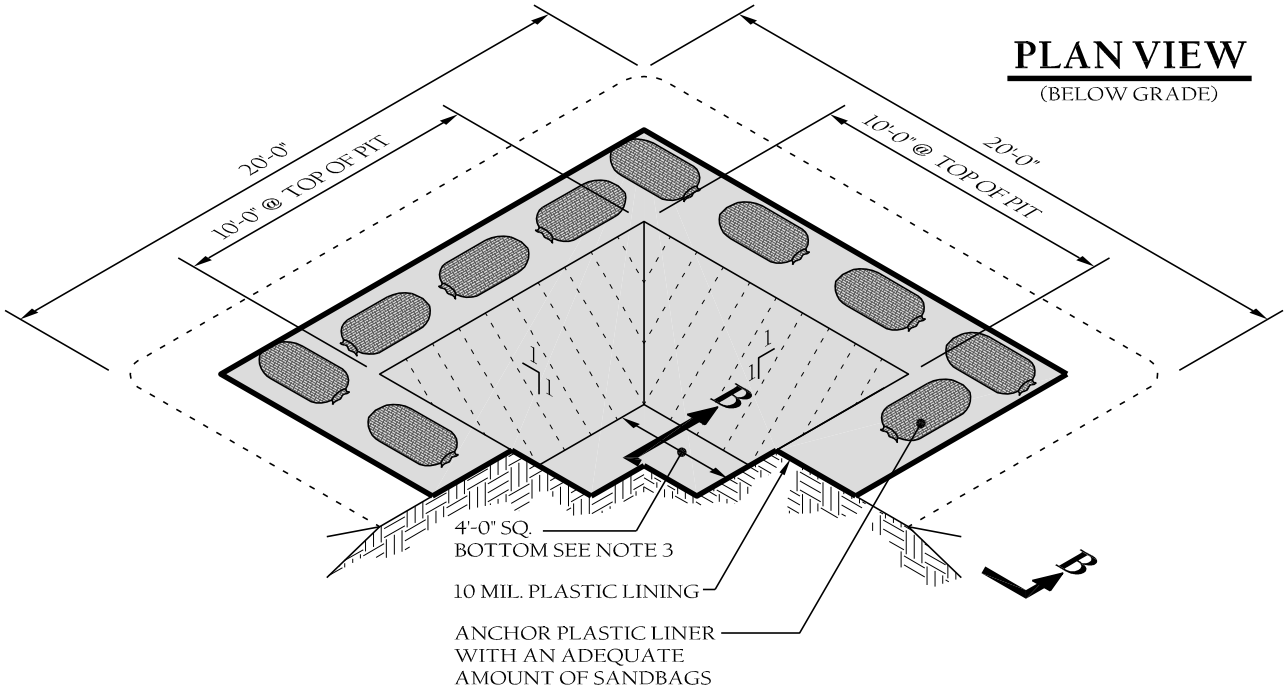

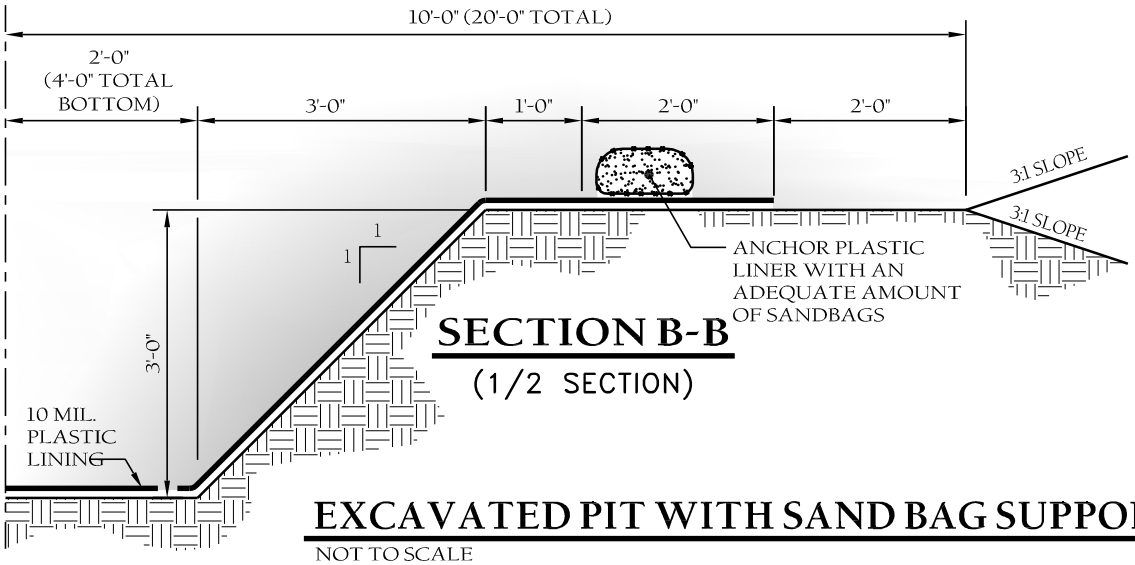

EXCAVATED PIT WITH SAND BAG SUPPORT

NOT TO SCALE

SAND BAG SUPPORT NOTES:

1. Actual layout to be determined in field.
2. The "concrete washout" sign shall be installed within 30 ft of the temporary concrete washout facility.
3. Pit capacity is minimum of 6 cu ft per 10 cu yd of concrete.
4. Contractor to coordinate with usage contracting officer for proper disposal of concrete.

TOWN of WAKE FOREST

TOWN of WAKE FOREST, NC

Manual of Specifications, Standards and Design

CONCRETE WASHOUT PIT DETAIL

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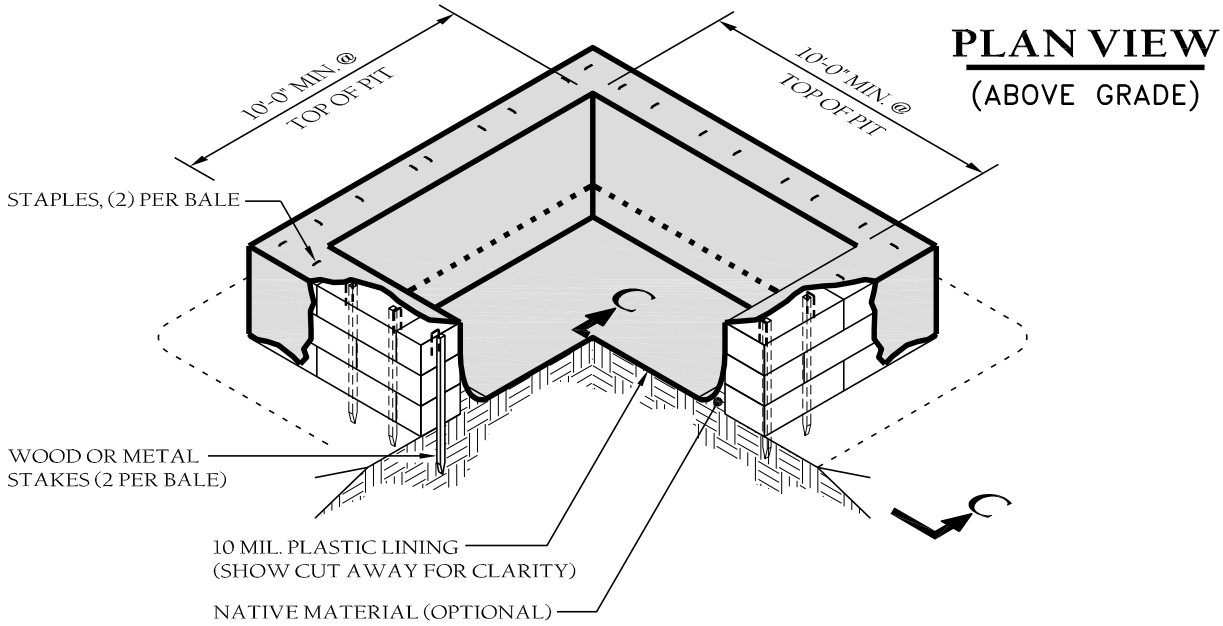
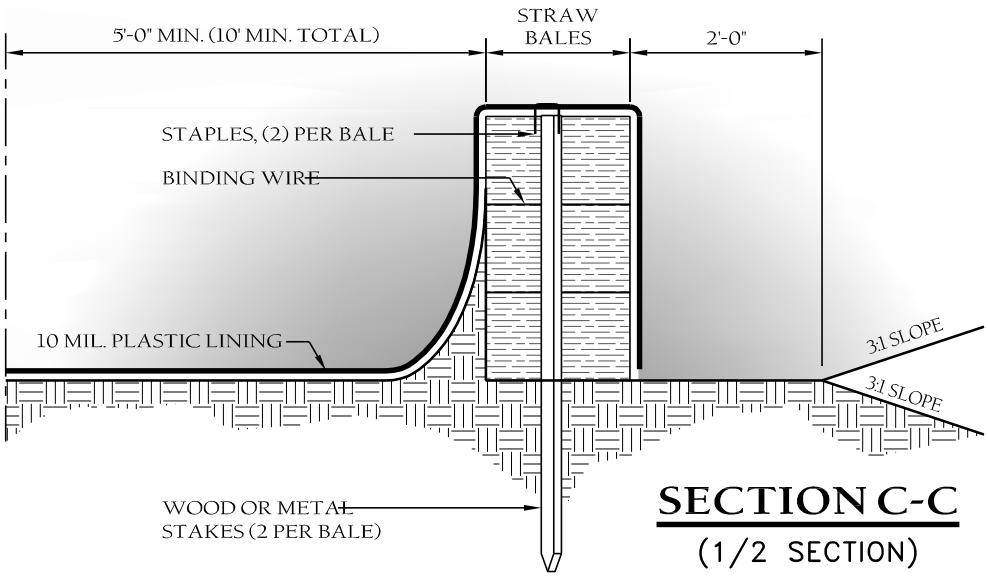
Feb., 2015	2 of 4





ELEVATED PIT WITH STRAW BALE DETENTION WALLS

NOT TO SCALE

STRAW BALE DETENTION NOTES:

1. Actual layout to be determined in field.
2. The "concrete washout" sign shall be installed within 30 ft of the temporary concrete washout facility.
3. Pit capacity is minimum of 6 cu ft per 10 cu yd of concrete.
4. Contractor to coordinate with usage contracting officer for proper disposal of concrete.

TOWN of WAKE FOREST	**TOWN of WAKE FOREST, NC** Manual of Specifications, Standards and Design		
	CONCRETE WASHOUT PIT DETAIL	Scale: Not To Scale	Detail #: 9.76
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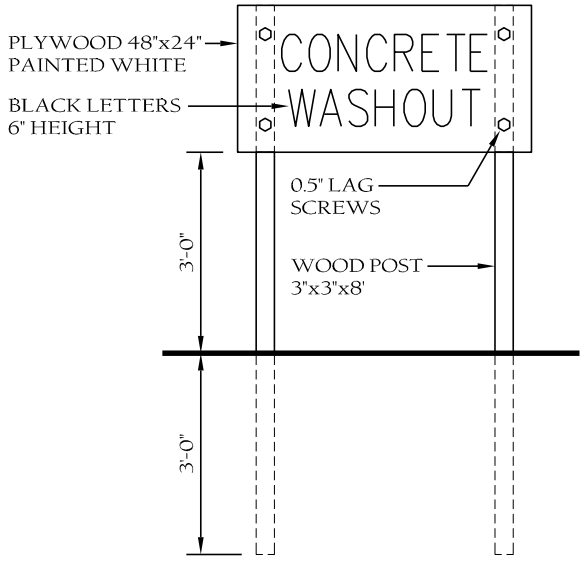

SIGN DETAIL

(OR EQUIVILANT)

CONCRETE WASHOUT DETAIL NOTES

Concrete washouts are used to contain concrete and liquids when the chutes of concrete mixers and hoppers of concrete pumps are rinsed out after delivery. The washout facilities consolidate solids for easier disposal and prevent runoff of liquids. The wash water is alkaline and contains high levels of chromium, which can leach into the ground and contaminate groundwater. It can also migrate to a storm drain, which can increase the pH of area waters and harm aquatic life. Revised NPDES and NC General Construction Permits require the use of concrete washout areas on all sites using concrete:

1. No concrete or cement slurry shall be discharged from the site.
2. Any hardened concrete residue shall be disposed of, or recycled on site, in accordance with local and state solid waste regulations.
3. Concrete washout area to be minimum 50' from storm drain inlets and surface waters (ie, detention pond, ditches, etc).
4. Prefabricated washout container or pit equal detail provided may be used if approved by Engineer.
5. Install concrete washout pit at all construction entrances used by concrete trucks.
6. Dimensions may be modified to fit topography. Provide minimum 100 Sf. of surface area level.
7. Locations shown on plans are for illustrative purposes only. Contractor shall determine final number of pits required, and their placement.
8. Inspection:
   a. Contractor to check all concrete washout facilities daily to determine if they have been filled to 75% capacity, which is when materials need to be removed.
   b. Both above- and below- ground self-installed washouts should be inspected daily to ensure that plastic linings are intact and sidewalls have not been damaged by construction activities. Contractor to repair plastic lining as needed.
   c. Prefabricated washout containers should be inspected daily as well to ensure the container is not leaking or nearing 75 percent capacity.
   d. Inspectors should also note whether the facilities are being used regularly.
6. Material Removal:
   a. Concrete washouts are designed to promote evaporation where feasible. However, if stored liquids have not evaporated and the washout is nearing capacity, vacuum and dispose of them in an approved manner - check with the local sanitary sewer authority to determine if there are special disposal requirements for concrete wash water.
   b. Remove liquids or cover the structures before predicted rainstorms to prevent overflows. Companies that offer prefabricated and watertight washout containers generally offer a vacuum service to remove the liquid material.
   c. Contractor to remove hardened solids or reuse onsite or haul them away for recycling.
   d. When removing materials from the concrete washout, building a new structure or, if the previous structure is still intact, Contractor is to inspect the structure for signs of weakening or damage and make any necessary repairs. Line the structure with new plastic that is free of holes or tears and replace signage if necessary. It is very important that new plastic is used after every cleaning because pumps and concrete removal equipment can damage the existing liner.
7. At completion of project, washout area to be backfilled and graded to be level with existing grade..
8. General Contractor is to educate concrete subcontractors, post signage indicating the location and designated use of these areas, and provide careful oversight to inspect for evidence of improper dumping of concrete waste and wash water. Contractor should include requirements in contracts with concrete delivery companies that drivers must use designated concrete washout facilities.

TOWN of WAKE FOREST

TOWN of WAKE FOREST, NC

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CONCRETE WASHOUT PIT DETAIL

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Board of Commissioners Work Session Agenda Item Report

Agenda Item No.: 2021-425-
Submitted by: Terry Savary
Submitting Department: Administration
Meeting Date: March 1, 2022

SUBJECT
Review of Draft Agenda for Upcoming Regular Meeting

Recommendation:

Item Summary:

ATTACHMENTS
- DraftBOCAgenda2022Mar15_Public.pdf

Wake Forest Board of Commissioners
Draft Meeting Agenda
March 15, 2022 at 6:00 PM
All items listed are for discussion and possible action.

Call to Order

Pledge of Allegiance

1. Approval of Agenda

2. Approval of Minutes

2.A. January 21, 2022, Board Retreat
February 1, 2022, Work Session
February 15, 2022, Regular Meeting

3. Presentations

3.A. Consideration of a Resolution of Appreciation for the Service of Beverly "Bev" Whisnant on the Historic Preservation Commission

3.B. Presentation regarding litter reduction efforts from Feb 2021-Feb 2022

4. Public hearings / Public Comment

4.A. Public Hearing to receive input for the FY 2022-2023 Budget

4.B. Public Hearing on and Consideration of LEGISTLATIVE ITEM TA-22-01 Text Amendment to the Unified Development Ordinance

4.C. Public Comment: If anyone would like to address the Board of Commissioners on an item other than a public hearing item during the time of public comment, please sign up with the Town Clerk prior to the meeting. Each speaker is asked to limit comments to 5 minutes. Please provide the clerk with copies of any handouts you have for the Board. Although the Board is interested in hearing your concerns, speakers should not expect Board action or deliberation on subject matter brought up during the Public Comment segment. Topics requiring further investigation will be referred to the appropriate Town Staff and may be scheduled for a future

agenda. Thank you for your consideration of the Board of Commissioners, staff and other speakers.

5. Consent Agenda

(A Consent Agenda is a group of items passed with a single motion and vote. These matters are of a generally routine nature. No debate is allowable on any item included on the Consent Agenda. If a Commissioner or any citizen of Wake Forest or its ETJ wants separate consideration of any item, it may be removed from the Consent Agenda by request.)

5.A. Approval of a resolution to schedule the public hearing and certify the sufficiency for a petition requesting non-contiguous annexation submitted by PNB Homes LLC, and Gail B Moody for properties located on Averette Road, being Wake County Tax PINs 1851-93-9056, 1861-02-0421, 1861-02-6148, 1851-91-9904, 1861-02-2044, 1861-02-6046, 1861-01-0709, 1861-01-4836. 1861-01-0635, and 1861-01-4639 and adjacent rights-of-way.

5.B. Approval of Budget Ordinance Amendment # 3 for FY 2021-2022

5.C. Approval of a resolution to schedule the public hearing and certify the sufficiency for a petition requesting contiguous annexation submitted by Andrew Ammons for property associated with Traditions Townhomes located at 0 Traditions Grande Boulevard being Wake County PIN 1851-12-8142 and adjacent rights-of-way being approximately 7.5617 acres.

5.D. Approval of resolution authorizing installment purchase agreement (FY 22 Police vehicles)

5.E. Approval of a resolution to schedule the public hearing and certify the sufficiency for a petition requesting contiguous annexation submitted by George C. Mackie Jr. and Martha Mackie, for property located on 1423 Deerfield Crossing Drive, being Wake County Tax PIN 1850-26-8976 and adjacent rights-of-way.

6. Legislative Items

7. Planning Items

7.A. Public Hearing on and Consideration of LEGISTLATIVE ITEM TA-22-01 Text Amendment to the Unified Development Ordinance

7.B. Resolution to approve Houseal Lavigne Associates for the Comprehensive Update of the UDO and MSSD scope of work and fee and allow the Town Manger to enter into a contract with Houseal Lavigne Associates.

8. Administration and Financial Items

8.A. Consideration of approval of amendment to Purchasing Policy

9. Public Services Items

10. Parks and Recreation Items

11. Public Safety Items

12. Other Business

12.A. Department Monthly Report

12.B. Wake County Tax Release

12.C. Commissioner Reports

12.D. "Closed Session: N.C.G.S. 143.318.11(a)(3) Consultation with the Town Attorney
Closed Session: N.C.G.S. 143.318.11(a)(3) Consultation with the Town Attorney:
Town of Wake Forest v. Pullen (20-CVS-12922)"

13. Adjournment