Chapel Hill Public Works Engineering Design Manual

Preface

PURPOSE

This document is intended to establish design and construction requirements and standards for the preparation and submittal of infrastructure improvement plans for subdivision and other site development projects within the Town of Chapel Hill. The designer on any project should use judgment and experience to determine any additional information that may be necessary for review.

These standards are meant to interpret and clarify the Land Use Management Ordinance and Design Guidelines of the Town of Chapel Hill. The Town's land use and development policies, as embodied in the Comprehensive Plan, are necessarily discussed in such broad terms as "livability", "public safety", and "variety of housing mix". The Comprehensive Plan contains community-wide goals and objectives which emphasize the existing character of the Town and its neighborhoods. The Land Use Management Ordinance and Design Guidelines deal with the more specific concepts such as types of use, lot sizes, and parking requirements.. However, even these more specific terms can be interpreted in a variety of ways, especially where a specific development in a specific location is being considered. Therefore, the Town of Chapel Hill Engineering Design Manual has been prepared to help people involved with site development in Chapel Hill and its planning jurisdiction to understand, before they begin, what will most likely be acceptable in this jurisdiction. These standards are intended to complement and supplement the general Design Guidelines included in the Comprehensive Plan.

Specific design criteria set forth in this manual provide a ready reference of those practices and techniques acceptable to the Town. We also encourage design professionals to consider site characteristics closely in their design and to seek new and innovative practices and techniques for complying with Town development policies and regulations. Designers are encouraged to offer alternative means of compliance to the design standards contained in this manual in the cases of challenging site characteristics, applicability of improved technology or innovative practices.

Where alternative means of compliance can be shown to conform to applicable policies and regulations, the Town may accept such alternatives in lieu of the standards contained herein. Similarly, where a particular site is characterized by a large number or extent of impediments to developing land in compliance with applicable policies and standards, or where technological changes provide for practices and techniques that better ensure compliance, the Town itself may modify or substitute additional standards for the design standards contained herein.

When there are deadlines for improvements the Manager may allow extensions of deadlines provided these extensions: (1) will not conflict with the intent of these standards and other land development regulations and; (2) include a practical justification for an extension.

The Public Works Engineering Design Manual and Standard Details will be updated as necessary, and the revised pages will be available from the Town of Chapel Hill Public Works Department and on the Town web site at http://www.townofchapelhill.org. It is recommended that any individual using this document contact the Engineering Division with suggested revisions. An errata sheet will be posted when updates are necessary.

COMPLIANCE

Compliance with these standards shall be required at the time property is developed, whenever a major increase in the intensity of use is created as determined by the Town Manager, or whenever a use group change occurs as outlined in the Town of Chapel Hill Land Use Management Ordinance (LUMO).

The Town Manager may exempt modifications to existing developments from individual provisions of these standards; where, in the opinion of the Town Manager, compliance with those provisions would create a practical hardship upon the property owner and where the modification does not increase an existing non-conformity.

Chapter 1
Definitions & Abbreviations

1.1 DEFINITIONS

Access Easement - A permanent easement, which grants the right to the public or specified party to access and/or cross private property.

Best Management Practices – Methods implemented as a way of treating or limiting pollutants and other damaging effects of stormwater runoff in order to meet legislative and North Carolina Administrative Code Requirements.

Bond - A type of surety that guarantees payment and/or performance, and insures against a financial lose.

Borrow - Fill material (soil), which is required for on-site construction and is obtained from off-site locations.

Cash Bond - Performance surety in which cash is deposited with the Town and held in lieu of a performance bond until the bonded work is completed.

Certificate of Occupancy - A permit issued by the Inspections Division, setting forth that a building or structure, complies with the Building Code, its use complies with the zoning ordinance, and that the same may be used for the purposes stated therein.

Contractor/Subcontractor - Individual or firm under contract with another to perform an agreed upon task.

Cross Drainage – Storm water drainage flow under a roadway though a culvert or across abutting parcels.

Curb Ramp - Access for pedestrian traffic at intersection of roadway, driveway or other pedestrian way.

Drainage Easement - A permanent easement, which grants the right of water drainage to pass in open channels or enclosed structures, the same does not obligate the Town to maintain any storm water devices, pipes, or open channels within the easement.

Drainage Maintenance Easement - A permanent easement, which grants to the Town the right to conduct pipe maintenance repairs, alter the typical drainage channel section and/or profile in order to improve water flow, the same does not obligate the Town to maintain any storm water devices, pipes, or open channels within the easement.

EAL Pavement Schedule - A pavement schedule based on an 18-Kip Equal Axle Load.

Easement - A grant of one or more of the property rights for a specific purpose by the property owner to, or for the use by, the public, a corporation, or other entity.

Engineer - A person licensed to practice engineering in the State of North Carolina.

Ephesus/Fordham Form Based Code – A form district intended for a specific area of the Town designated as a focus area in the Comprehensive Plan 2020.

Erosion - The wearing away of land surface by the action of wind, water, gravity, or any combination thereof.

Erosion Control Plan - An erosion and sedimentation control plan.

Fee "In Lieu of Infrastructure Improvements"- A non-refundable payment to the Town to compensate for needed and/or required infrastructure improvements that may be used in the future by the Town to make such infrastructure improvements adjacent to the subject development.

Final Plat - The final map of all or a portion of a subdivision or site, showing the boundaries and location of lots, streets, easements and all other requirements of subdivision regulations.

Formal Street Side Parking – Parallel or angle parking which is adjacent to and contiguous with the travel way of the street and anticipated to occur on a frequent basis.

Grade, Finished - The final elevation of the ground surface after development.

Grading - One of two (2) types of grading, rough or fine.

Ground Cover - Any natural vegetative growth, masonry, paving, riprap or other material, which renders the soil surface stable against accelerated erosion.

Hi-Visibility Crosswalks – A location indicated as an appropriate place for pedestrians to cross a street or vehicular way by marking the crossing location with high visibility crosswalk pavement markings. These crosswalks typically make use of longitudinal or "continental" or "ladder" style pavement markings, which are highly visible to approaching traffic.

Informal Street Side Parking – Parallel parking on a street where parking is anticipated to be on an occasional basis.

Inspector - The Building Inspector, Engineering Inspector, or other representative duly authorized by the Town to inspect public and private infrastructure improvements.

Land Use Management Ordinance (LUMO) – The compilation of regulations that affect land use, including the zoning, the environmental regulations, and other land use regulations.

NC DEQ - The North Carolina Department of Environment Quality

Pedestrian Access Easement - A permanent easement dedicated to the public to facilitate pedestrian access to adjacent streets and properties.

Performance Bond - A bond for 125 percent of the estimated cost in which the surety company has an obligation to the Town for any additional cost to complete a given project due to the developer's or owner's failure to properly complete the bonded work. A Letter of Credit from a bank or savings & loan, with a branch in North Carolina, bond, certified check, or cash deposit may serve as a performance bond when bonding infrastructure improvements for the Town.

Plans - The approved plans, profiles, standard details, supplemental plans, and working drawings, which show the location, dimensions, and details of the work to be performed.

Plat - A map of a surveyed parcel of land which is intended to be, or has been, recorded in the Orange County Office of the Register of Deeds.

Preliminary Plat - A map indicating the proposed layout of a subdivision or site showing lots, streets, easements, and other requirements of subdivision regulations.

Preliminary Site Plan Are the initial design phase in preparing the construction design documents. Typically the preliminary plans are schematics and design development drawings that allows the Town and architect/engineer to interact before the design is developed, helping to ensure a mutual understanding of the design objectives, limitations and budget.

Private Drive - A vehicular travel way, centered within an access easement, which serves more than two (2) residential lots or more than 2 principal buildings in a multi-family housing development or other non-single-family residential development. An individual entity or property owners association shall maintain private drives. Street side parking spaces, (parallel and angle), are allowed on private drives. Parallel and angle parking spaces shall not protrude into the primary travel way.

Private Street - A vehicular travel way, permitted in developments where property owner associations exist. Private streets shall undergo the same approval process and meet the same design and construction standards as public streets. Private streets may be approved only by Council action.

Public Street - A vehicular travel way within a dedicated and recorded public right-of-way or public easement.

Sidewalk Easement - A permanent easement, which grants the right for a public sidewalk to be placed and maintained thereon.

Sight Easement - A permanent easement, which grants the Town, the right to maintain an unobstructed view across properties primarily located at street intersections, driveways and sharp horizontal curves in the roadway. (The same does not obligate the Town to maintain such).

Site Plan – A development plan required by virtue of the provisions of the LUMO as a condition for the issuance of a permit for development.

Sketch Plan - A rough sketch map of a proposed subdivision or site, showing streets, lots, and any other information of sufficient accuracy to be used for discussion by owner, developer and/or staff, of the street system and the proposed development pattern.

Slope Easement - A permanent easement, which restricts the degree of slope on property and upon which slope cannot be increased.

Stabilizing Vegetation - Any vegetation that protects the soil against erosion.

Standard Specifications – A general term referring to all provisions and requirements contained herein entitled "Roadway Design and Construction Specifications" and any subsequent addendums or revision thereto.

Street - A vehicular travel-way, which provides a means of access and travel. The term street may include road, avenue, place, way, drive, lane, boulevard, parkway, highway, and any facility principally designed for vehicular and pedestrian traffic.

Stub-out Street - A street, which runs to a property line of adjacent property and is intended to continue into adjacent property at such time as the adjacent property is developed.

Subgrade - That portion of the roadbed prepared as a foundation for the pavement structure.

Substantially Completed - Work has progressed to the point that, in the opinion of the Public Works Director, it is sufficiently completed in accordance with the approved plans and specifications that the improved area can be utilized for its intended purposes.

Surety – A guarantee against loss or damage from one's failure to perform and a physical or financial guarantee for the fulfillment of an obligation. Performance Sureties may be in the form of Standby Letters of Credit, Performance Bonds, Certified Check, or Cash.

Surveyor - A person licensed to practice surveying in the State of North Carolina.

Temporary Construction Easement - A temporary easement ,which grants the right for the Town, NCDOT or other public utility provider to encroach upon the temporary construction easement while making improvements to public infrastructure and/or public utilities.

Utilities - Facilities of an agency which, provide the general public with electricity, gas, oil, water, sewage, communications, or rail transportation.

Utility Easement - A permanent easement, which grants to the Town and other public utility providers the right to install and thereafter maintain any and all utilities including, but not limited to; water lines, sewer lines, storm sewer lines, electrical power lines, communication lines, natural gas lines, and cable television systems.

Utility Easement (Private) - A permanent easement, which grants the right to install and maintain a private utility across private property. A Private Utility Easement can be granted to an individual, a utility company, a property owners association or to owners of a specified parcel of land.

Wetlands - Areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support and, under normal circumstances, do support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas as delineated by the US Army Corp of Engineers or certified professional in the field of environmental engineering as approved by the US Army Corp of Engineers.

Working Day - Monday through Friday exclusive of Town holidays.

1.2 ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ABC	Aggregate Base Course
ADT	Average Daily Traffic Count
AIA	American Institute of Architects
ANSI	American National Standards Institute
APWA	American Public Works Association
ASPH	Asphalt
ASTM	American Society of Testing and Materials
AWWA	American Water Works Association
BC	Back of Curb
BC-BC	Back of Curb to Back of Curb
BST	Bituminous Surface Treatment
CATV	Cable Television
CAP	Corrugated Aluminized Pipe
CB	Catch Basin
CFS	Cubic Feet per Second
C&G	Curb and Gutter
CI	Curb Inlet
CIP	Cast Iron Pipe
CL	Centerline
CMP	Corrugated Metal Pipe
co	Sanitary Sewer Cleanout (Drawings)
CO	Certificate of Occupancy
CONC	Concrete
CPP	Corrugated Plastic Pipe
DE	Drainage Easement
DI	Drainage Inlet
DIP	Ductile Iron Pipe
DME	Drainage Maintenance Easement
DMUE	Drainage Maintenance and Utility Easement
EP	Edge of Pavement
ETJ	Extra Territorial Jurisdiction
ex	Existing
FF	Face to Face

FOC	Fiber Optic Cable
G	Gas
GV	Gas Valve
HYD	Hydrant
HDPE	High Density Polyethylene Pipe
ID	Internal Diameter
JB	Junction Box
LP	Light Pole
LUMO	Land Use Management Ordinance
MSL	Mean Sea Level
MUTCD	Manual on Uniform Traffic Control Devices
NC DEQ	North Carolina Department of Environment Quality
NC EMC	North Carolina Environmental Management Commission
NC DOT	North Carolina Department of Transportation
NEC	National Electric Code
OD	Outside Diameter
P.C.	Point of Curvature
PDE	Permanent Drainage Easement
PE	Professional Engineer
PED	Pedestal
PH	Phone
PINC	Point of Intersection
P/L	Property Line
PLA	Professional Landscape Architect
PLS	Professional Land Surveyor
PP	Power Pole
ppm	parts per million
PROP	Proposed
psi	pounds per square inch
P.T.	Point of Tangency
P.V.C.	Point of Curvature on Vertical Curve
P.V.T.	Point of Tangency on Vertical Curve
PVMT	Pavement
Qmax	maximum discharge
Qmin	minimum discharge
R/W	Right of Way
RCP	Reinforce Concrete Pipe

SD	Storm Drain
SS	Sanitary Sewer
STD	Standard
TBC	Top Back of Curb
TC	Top of Curb
TCE	Temporary Construction Easement
TST	Temporary Sediment Trap
UDO	Unified Development Ordinance
UE	Utility Easement
VCP	Vitrified Clay Pipe
WCR	Wheel Chair Ramp
WL	Water Line
WM	Water Meter

Chapter 2
General Provisions

2.1 GENERAL

For approval of street design, a North Carolina Registered Professional Engineer must seal all construction plans and revisions submitted to the Engineering and Design Services Division, with the exception that the Town will accept for approval, street designs sealed by a North Carolina licensed design professional (PLS, PLA) in those circumstances allowed by North Carolina General Statutes. A digital copy in drawing file (*.dwg) format of the "Record Drawing" of the development must be submitted before final acceptance and maintenance of any streets and storm drainage systems. The digital files must be tied to the State Plane Coordinate System.

All proposed public streets shall be designed to become part of the overall street system and be identified as such on all adopted plans. All streets and roads shall align with other designated roadways for continuity in the Town's street system.

All single family residential subdivisions shall be accessed by public streets except those wherein private streets have been approved in accordance with the provision of the Land Use Management Ordinance (LUMO).

If there are any conflicting term or requirements between this manual and the LUMO the LUMO shall govern.

The latest revision of the *NC DOT Standard Specifications for Roads and Structures*, *NC DOT Design Manual*, *NC Stormwater Best Management Practices Manual, The NC Erosion and Sediment Control Planning and Design Manual, The AASHTO Policy on Geometric Design of Highways and Streets, and the Manual on Uniform Traffic Control Devices* shall apply to all roadway and storm drainage construction unless otherwise specified herein this manual.

Dedication of additional right-of-ways, easements, construction of turn-lanes, roadway widening, or other improvements to existing public streets upon which the property fronts or which provide access to new developments may be required as provided for in the LUMO or the Ephesus/Fordham Form Based Code. In some cases the proposed development may be adjacent to roadways, utilities, drainage systems, etc. in which, a large scale infrastructure improvement project may be needed. In such cases, the Town may elect to collect a fee "In-lieu-of Infrastructure Improvements" to be used on a larger scale improvement project adjacent to the development. This process is encouraged on high volume roads where small piecemeal improvements may result in poor construction methods, impaired ride quality, and excessive inconvenience to the public.

2.2 APPEALS

Any decision of the Town Manager made in the administration of the provisions of this Manual may be appealed to the Board of Adjustment in accord with the provisions of Article 4.10 of the LUMO Ordinance.

2.3 BUILDING SIGNS

Signage is an important element which contributes to the character of Chapel Hill. The two predominant signage types which most contribute to place making in Chapel Hill are on-site signage (signs used to identify a place of business or a residential building); and wayfinding elements which are placed in the public realm to provide directional assistance or location information to pedestrians and motorists.

The quantity and quality of all signage should be considered in a comprehensive manner within a development but should also be complementary between neighborhoods.

Building identity signs are generally auto-oriented and intended to be seen from a distance. They are usually located in the top half of the building, closer to the roofline, and are the largest signs in an urban area. Signs should be sized for legibility, but also appropriate to the scale of surrounding buildings. They are intended to identify the name of a building or the name of a major tenant within the building. Building identity signs can also contribute to the identity of the skyline by providing visual interest when they are well-integrated into the building architecture.

2.4 ADDRESS NUMBERS

Address numbers must be a minimum of four (4) inches high and of contrasting color to their background. Reflective numbers are preferred and required on front and rear doors of strip shopping centers.

Distance from the Street:

- When the distance from the street or fire department access lane to the front or address side of the building exceeds twenty-five (25) feet, larger numbers are required;
- Twenty-six (26) feet to fifty (50) feet shall have eight (8) inch numbers;
- Fifty-one (51) to seventy-five (75) feet shall have twelve (12) inch numbers; and
- Greater than seventy-five (75) feet shall have eighteen (18) inch numbers.

Where access by private means of a private road and building cannot be viewed from the public way, a monument, pole or other sign or means shall be used to identify the structure.

Chapter 3
Streets, Parking and Transportation

3.1 GENERAL

Required Access

All development must provide access to publicly maintained vehicular, bicycle, and pedestrian facilities, as defined below:

> *Vehicular Access* - access to a street which is approved by the Town as being in compliance with Town standards and/or is currently maintained by the Town or the State of North Carolina.
>
> *Bicycle Access* - access to a street or recreation area/space containing a bikeway (bike lanes, bike paths, bike trail, multi-use paths, multimodal, etc.) or abutment on a street for which bikeways are not required. (Such streets are presumed to be adequate for combined vehicular/bicycle traffic.)
>
> *Pedestrian Access* - access to a street or dedicated recreation area/space containing a pedestrian way (sidewalks or pedestrian trail), or abutment on a street for which sidewalks are not required.

Nothing in the above definition of access shall be deemed to preclude the Town's authority to require improvement of substandard access ways to applicable standards. At a minimum, access ways shall have an engineered all weather surface which will reasonably accommodate routine service vehicles and emergency vehicles.

Relationship to Town Plans

Streets, including associated bikeways, sidewalks, trails, multi-use paths, and transit amenities, shall be arranged, designed, and located in conformance with adopted Town plans including but not limited to the Land Use Plan, Mobility and Connectivity Plan, Street Classification Plan, Entranceways Plan, Greenways Plan, Transit Plans, the Ephesus-Fordham Regulating Plan and Small Area Plans.

Some Town plans may include different design guidelines for specific areas of Town.

Relationship to Surrounding Access Ways

Streets, including associated bikeways, sidewalks, trails, multi-use paths, and transit amenities, shall be appropriately related to, and coordinated with, surrounding existing and proposed roadways, bikeways, and pedestrian ways and transportation patterns. Roadways, bikeways, and pedestrian ways shall connect where necessary to permit the convenient and safe movement of traffic. While street connections are encouraged, connections to local streets should be designed to minimize their use by through traffic.

To provide convenient access for pedestrians each new development should:

1. Provide walkways with direct access to adjacent developments, neighborhoods, parks, bus stops and street sidewalks or an alternative pedestrian system.
2. Investigate the possibility of using utility easements as connecting trails.
3. Preserve existing trails unless a superior alternative is provided.
4. Install pedestrian signals at intersection and pedestrian islands on roads when warranted.
5. Provide walkways through and from parking areas to buildings, other than drive aisles.
6. Construct walkways along all public streets unless existing conditions dictate

otherwise.

7. All crosswalks should be clearly marked with paint, thermo-plastic, hi-visibility, or contrasting surface material in compliance with The Manual on Uniform Traffic Control Devices (MUTCD).
8. Provide bicycle and pedestrian access to adjacent greenways.
9. Design modifications may be approved based on site specific conditions, neighborhood character and existing infrastructure.

Extension and Completion of Access Ways

Extension to Boundaries - Streets, bikeways, and pedestrian ways to be extended onto adjacent property or into subsequent approved phase(s) of a single development shall be constructed to the common property line or phase boundary. Where necessary to facilitate traffic flow or accommodate emergency vehicles, a temporary turnaround may be required at the end of a street pending its extension. Turnarounds or cul-de-sacs are required for street extensions greater than 150 feet. Extension beyond the boundaries may be required, where right-of-way exists, to create connectivity.

Improvement of Substandard Access Ways - Where a development impacts, abuts or contains an existing street, bikeway, or pedestrian way which provides required access but does not meet the standards contained herein, improvement of such access way to applicable standards may be required if the development is expected to increase traffic volume and/or affect the capacity of the existing facility. This may involve off-site improvements of the access way. Partial width access ways shall be prohibited and abutting existing partial width access ways shall be completed to applicable standards.

Public and Private Access Ways

Public Access Ways - Public access ways are streets, alleys, bikeways, and pedestrian ways located within publicly dedicated rights-of-way or easements and accepted for maintenance by the Town of Chapel Hill or the State of North Carolina. Public access ways shall not be accepted for maintenance unless they meet all applicable standards.

Private Access Ways Providing Required Access - Private access ways are streets, bikeways, and pedestrian ways located on private property. Where private access ways provide required access, they shall meet all applicable standards. Provision for their continued maintenance shall be approved by the Town Manager and recorded with the Orange County Register of Deeds in a legally valid and binding instrument which describes the properties the private access way serves. The recorded document runs with the land. The maintenance agreement shall apply to all properties which the private access ways serve. It shall contain a provision which, at any such time the private access way is no longer maintained to applicable standards, the Town of Chapel Hill, Orange County, or the State of North Carolina, as appropriate, may provide such maintenance, with the total costs of required maintenance assessed to those properties subject to the agreement.

Encroachments in the Public Right-Of-Way

An encroachment is an installation which is owned by an individual(s) or business entity within the street right-of-way. Generally, an encroachment agreement is required for all installations when a foundation or footing is necessary for the encroachment, any installation above or below grade which may inhibit the public use of the available space in the right-of-way or create potential maintenance difficulties for the Town. Some examples of encroachments are fences, walls, mail box on a foundation, significant landscaping, above ground communication boxes, aerial and underground cable, and private irrigation systems.

The Town Manager or Director of Public Works may approve temporary encroachments after staff review to ensure the public's safety and welfare. To apply for an encroachment the requestor must contact the Engineering & Design Services Division and provide a description of the proposed encroachment including a sketch showing the dimensions with the proposed location. If approved, the applicant must fill out the Encroachment Agreement and attach an 8 1\2 inch by 11 inch exhibit showing the installation and location (see Appendix A for sample). After all signatures the applicant is asked to record the agreement at the Orange County Register of Deeds and send a copy of the recorded document to the Engineering & Design Services Division.

Prior to placement or maintenance of facilities in the public right-of-way in situations where the Town does not issue franchises, the Director of Public Works or designee shall determine, in his/her discretion, the necessity of and type of encroachment, taking into consideration the length of time the facilities will be in the public way and the potential impact on the public way. Facilities for which an encroachment agreement shall be required include monument signs, monument mailboxes, fiber optic cable, irrigation systems, specialty street signs, canopies, specialty pavement structures, and other features.

> *Monument mailboxes encroachment.* A monument mailbox is a mailbox with a foundation and/or mailbox that services multiple residences. A monument mailbox encroachment may be granted by the Town's Public Works Department for the owner to construct and maintain a monument sign and/or monument mailbox within the public way.
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> *Telecommunications encroachment.* A telecommunication encroachment may be granted to construct and maintain equipment which transmits/communicates between points specified by the user and provides services regulated under the Federal Telecommunications Act of 1996 and are not subject to a franchise agreement. This equipment shall be referred to as a telecommunications system. The Town Council may grant a telecommunications encroachment for users proposing to construct and maintain telecommunications system within the public way. Screening for above ground installations may be required.
>
> *Encroachments for other facilities.* The Public Works Department may grant a temporary encroachment to construct and maintain other facilities not included above.

3.2 DESIGN CONTROLS AND CRITERIA

Street Classifications and Geometric Standards
Street classifications and geometric design standards are outlined in Tables 3.1 and 3.2. Information regarding existing streets and their classifications is available in the Chapel Hill.

All streets within the Town limits are classified primarily by functional and/or operational characteristics, rather than by specific geometric criteria.

The street design standards represent specific interpretations of the general intentions embodied in the Town of Chapel Hill Land Use Management Ordinance and Design Guidelines as well as the Ephesus-Fordham Form Based Code. Because the terrain of Chapel Hill varies from level to hilly, the standards have been written as broadly as possible. The notion of limiting cut and fill within the limits of public safety has been important in developing these standards.

The conscientious designer may occasionally find street design in specific areas could be better accomplished in a manner which does not coincide with every standard in Tables 3.1 and 3.2. In such cases, the Town Manager will consider whether strict adherence to all standards would create significantly undesirable conditions and/or deviation from the standards would produce a significantly better improvement. Similarly, the Town Manager may not allow the use of a standard if public safety considerations dictate otherwise under specific conditions.

The standards in Table 3.2 are presumptive. They are intended to be valid in most cases, but it is understood public interest may be better served in certain unique situations by allowing some flexibility in the standards. New streets should be designed in a manner which balances functional and safety needs with the objective of preserving as much of the existing terrain and vegetation as is practicable.

Streets in Chapel Hill are classified by their functional relationship to through-traffic service and land-access service. The three primary street classifications and functions are:

> *Arterial* - Arterial streets function primarily to serve through-traffic movement. Limited land-access service may be accommodated, but traffic controls and street design are intended to provide efficient through-traffic movement.
>
> *Collector* - Collector streets penetrate neighborhoods, public service areas, and districts. They are intended to provide both through-traffic and land-access services in relatively equal proportions, often linking the local street system to the arterial street system.
>
> *Local* - Local streets primarily serve land-access functions. They are intended to accommodate land parcel ingress and egress. Through-traffic movement is difficult and discouraged by traffic controls and street design.

The relationship between functional street classifications is a continuous one, without specific clear-cut boundaries. Streets are classified by the Town's Traffic Engineering Services Manager and Transportation Planning Manager based on technical judgment and observed function of the street. A list of existing street classifications is available from Town's Public Works Department or Department of Planning and Sustainability Department. The list will be updated as new streets are approved by the Town.

By definition herein, a private street is a means of vehicular ingress or egress not publicly maintained and serves more than two single family lots, or as part of a privately maintained street system approved as part of a Special Use Permit or other Council approval.

The provision of sidewalks on both sides of the street is required; however, subject to staff review, sidewalks can be omitted on one side of new streets where site constraints preclude construction and where there are no existing or anticipated uses which would generate pedestrian trips. Where there are service roads, the sidewalk adjacent to the main road may be eliminated and replaced by a sidewalk adjacent to the service road on the side away from the main road. For rural roads likely to serve development, a shoulder of at least four (4) feet in width, preferably eight (8) feet on primary highways, should be provided. Surface material should provide a stable, walking surface.

Table 3.1
Geometric Design Standards for Streets and Intersections

	Arterial 12 Foot Lane			Collector 11 Foot Lane			Local 10 Foot Lane		
	Level	Roll	Hilly	Level	Roll	Hilly	Level	Roll	Hilly
Terrain Type (% Grade)	<8	8-15	>15	<8	8-15	>15	<8	8-15	>15
Vertical Curve "K" Value[1] (Crest/Sag)	55/ 55	45/ 45	40/ 40	40/ 45	28/ 35	20/ 20	28/ 35	20/ 20	15/ 20
Stop	20	14	9	14	9	7	9	7	5
Street Grade (%) (Max./Min.)	4/1	6/1	8/1	4/1	8/1	12/1	5/1	10/1	15/1
Min. Horizontal Street Center-line Radius (ft) *Super-elevated	500 *NA	425 *NA	350 *NA	300 *400	250 *350	200 *300	200 *250	150 *175	100 *100
Typical Shoulder Width for Streets Without Curb and Gutter or Sidewalk (ft.)	12	10	8	10	8	6	8	6	4
Minimum Street Corner Radius at Intersections	40	40	30	30	30	30	20	20	20
	For R/W See Typical Sections			For R/W See Typical Sections			For R/W See Typical Sections		

Figure 3.1 Notes:

1. *Vertical Curve "K" Value - Used in computing the minimum length of vertical curve from the formula L=KA where: L = Length of Vertical Curve (100 ft.); K = Design Constant; A = Algebraic Difference of Connected Grades (%).*
2. *Street and right-of-way widths will vary depending on specific combinations of utility requirements, sidewalks, traffic lanes, turn lanes, parking lanes, bike lanes, bus pull-offs, multimodal paths, etc. See typical street cross-section drawings for more details.*
3. *All streets with centerline or one-way crowns should be designed with a 2% cross slope. This does not apply to super-elevation designs on curves.*
4. *Intersecting streets should be designed to create 90° intersection angles. The minimum allowable angle of intersection is 75° under special conditions.*
5. *Intersection sight distance criteria and other related information are shown in the standard details.*
6. *Unless specified herein the American Association of State Highway and Transportation Officials (AASHTO) guidelines and standards will apply where appropriate*

Vertical Alignment - Streets should be designed to provide gradual grade changes and to avoid a "roller coaster" effect. Where possible, streets should be designed to avoid deep cuts and fills.

Horizontal Alignment - Streets should be designed to provide long curves and to avoid sharp curves at the end(s) of straight sections or flat curves. Compound curves and "S" curves are to be avoided.

Minimum Street Elevations - Minimum elevations for crown of arterial street pavements shall be two (2) feet above the one hundred (100) year flood elevation as shown in the Flood Insurance Study Flood Boundary and Floodway Maps and Flood Insurance Report. Streets, bridges, and other similar transportation facilities are permitted in the Resource Conservation District only upon approval of a Special Use Permit or a Subdivision application by the Town Council or by a variance granted by the Board of Adjustment.

Guardrails and Barriers - Physical barriers (such as guardrails) should be provided along roadway edges and in medians where warranted due to potential roadway safety hazards such as structures, embankments, ditches, or bodies of water. Refer to NCDOT guidelines. Guardrail shall be constructed within the right of way wherever the Town determines they are necessary. Generally, guardrails will be required if a fill slope is steeper than 3:1 with a fill height greater than eight feet, or as necessary adjacent to bridges and large culverts.

Reflectorized end of road markers (per MUTCD) shall be installed at the end of pavement on all streets or drives which are temporarily dead ended or when a “T” turnaround is installed. The types(s) of barrier(s) required will be determined by the Town.

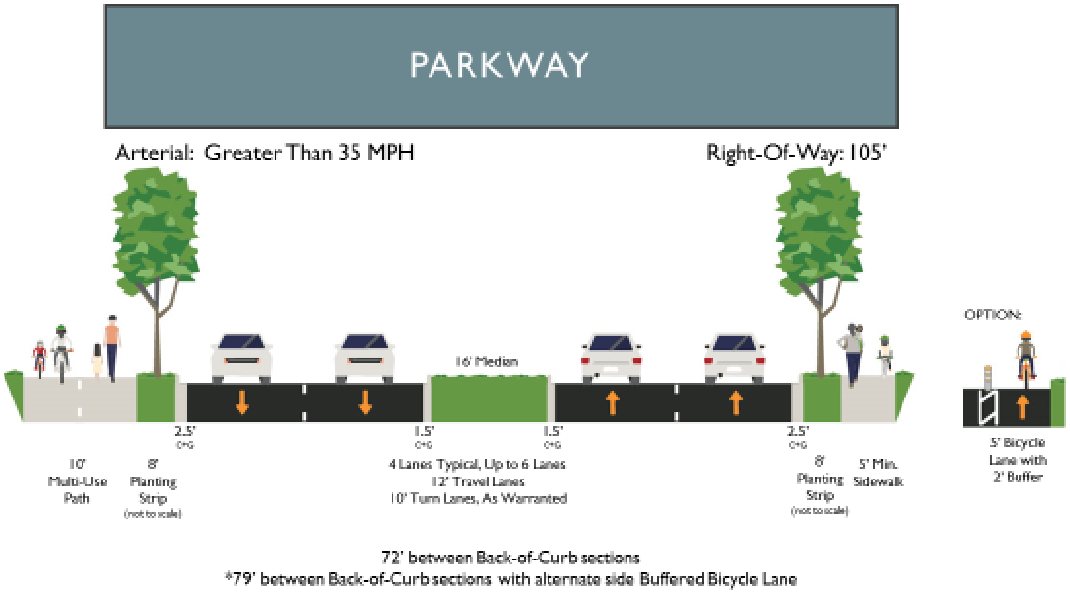
I**ntersections -** Intersections of streets should be designed to minimize the number of potential conflicts among vehicular movements; to give; to coordinate the location and alignment of driveways; to discourage dangerous vehicular movements; to avoid multiple and compound merging and diverging maneuvers; and to provide adequate sight distances, and designed to assure adequate visibility for vehicles and pedestrians using the intersection. Signs, trees, shrubs, etc. should not interfere with these sight lines. The property owner shall dedicate sight line easements as necessary.

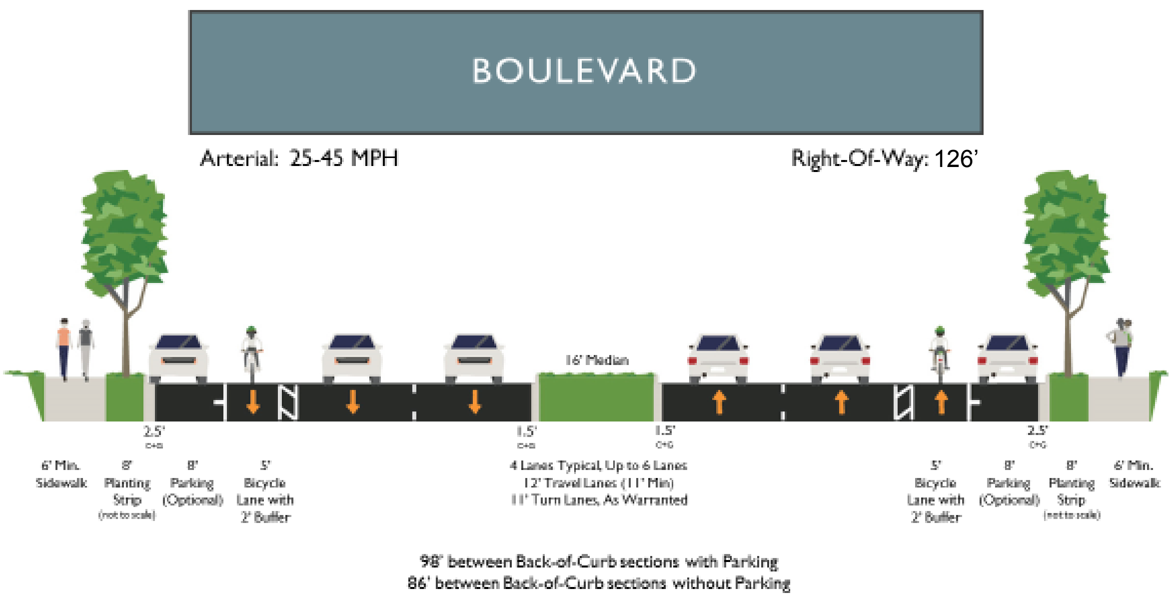
Table 3.2 Street Standards

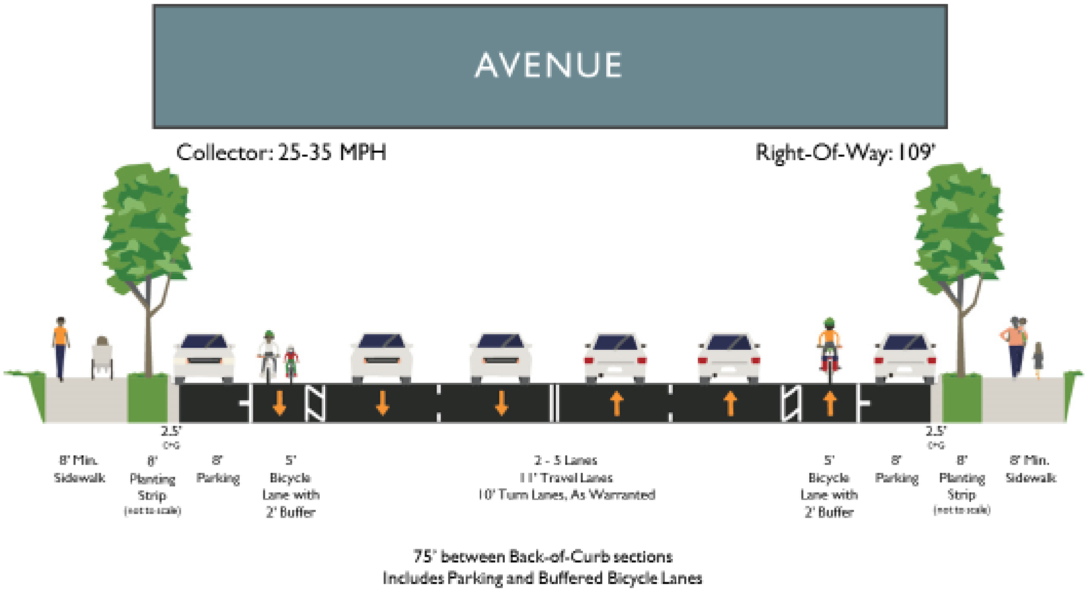
Main Street Classification	Street Sub Classification	Function	Design Speed	Lane Width	Number of Travel Lanes	Turn Lanes	Bike Lanes	Sidewalks	On-Street Parking	Intersection Spacing	Driveway Spacing	Planting Strip
Arterial	Boulevard	Arterial	25-45 mph	12 feet 11' minimum	4 to 6 Lanes (4 lanes typical)	As warranted by traffic volume (minimum 11' width)	5' + 2' Buffer at 35 MPH and greater speeds	Minimum 6' unobstructed; Minimum 10' with 0' setback	Separate, parallel facility; 8' from face of curb	1000' 800' in Business District	500' minimum between driveways	8'
Arterial	Parkway	Arterial	>35 mph	12 feet 11' minimum	4 to 6 Lanes (4 lanes typical)	As warranted by traffic volume (minimum 10' width)	Multi-Use Path; Alternate is 5' with 2' Buffer	6' Unobstructed or Separate parallel multi-use path	No	Minimum 1200'	600' or subject to Engineering Review	8'
Collector	Main Street	Collector	20 to 25 mph	11 feet	2 lanes	As warranted by traffic volume (minimum 10' width)	5'	Minimum 10' unobstructed	Parallel, 8' from face of curb	Not to exceed 400'	50' minimum between driveways	8'
Collector	Avenue	Collector	25 to 35 mph	11 feet	2 to 5 lanes	As warranted by traffic volume (minimum 10' width)	5' with 2' Buffer at 35 mph	Minimum 8' unobstructed	Parallel, 8' from face of curb	400' Minimum Not to exceed 600'	50' minimum between driveways	8'
Local	Local/Subdivision Street	Local Residential	25 mph	11 feet; 9' feet if parking on one side	2 lanes	As warranted by traffic volume (minimum 10' width)	None	Minimum 5' unobstructed	Allowed	100'	Varies subject to Engineering Review	3'
Local (Public or Private)	Local/Subdivision Street	Local Commercial	20 to 25 mph	11 feet	2 lanes	As warranted by traffic volume (minimum 10' width)	Shared – No striped bike lanes	Minimum 10' unobstructed	Minimum 8' from face of curb	Varies subject to Engineering Review	50' subject to Engineering Review	8'

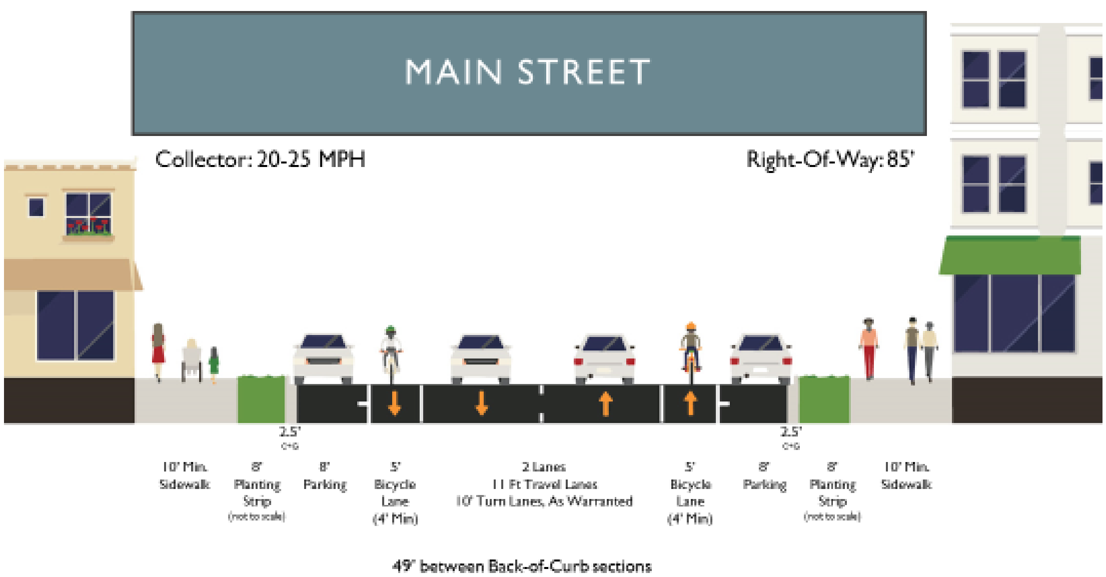
Note: All measurements between driveways and intersections are from edge of pavement to edge of pavement.
Note: Transit Provisions will be determined by transit and as warranted by this manual.
Note: Planting Strip Width may vary if the street is located in the Ephesus Fordham District – Type A, Type B, or Type C Frontage.
Note: Street cross-section elements may vary if the street is located in the Ephesus Fordham District – Type A, Type B, or Type C Frontage. See Ephesus Fordham section of Chapter 3.
Note: On-Street Parking is not allowed within 50 feet of any street intersection.
Note: Sidewalks may be identified as sidepaths or multiuse paths identified in the Greenways/Mobility and Connectivity/or other Town Master Plans. These identified sidepaths must be constructed of concrete, see Town Detail PR-5.00.
Note: Driveway Access Local Streets – No driveway connection permitted within 50 feet of a street intersection.
Collector Streets – No driveway connection permitted within 100 feet of a street intersection. Residential driveway access is restricted if driveway access is available on a Local street.
Arterial Streets – No driveway connection permitted within 150 feet of a street intersection. Driveway connections are not allowed on an Arterial Street if access is available from a Collector or Local Street.

GRAPHIC STREET SECTIONS






AVENUE
Collector: 25-35 MPH
Right-Of-Way: 109'
2.5' C+G
2.5' C+G
8' Min. Sidewalk
8' Planting Strip (not to scale)
8' Parking
5' Bicycle Lane with 2' Buffer
2 - 5 Lanes
11' Travel Lanes
10' Turn Lanes, As Warranted
5' Bicycle Lane with 2' Buffer
8' Parking
8' Planting Strip (not to scale)
8' Min. Sidewalk
75' between Back-of-Curb sections
Includes Parking and Buffered Bicycle Lanes


MAIN STREET
Collector: 20-25 MPH
Right-Of-Way: 85'
2.5' C+G
2.5' C+G
10' Min. Sidewalk
8' Planting Strip (not to scale)
8' Parking
5' Bicycle Lane (4' Min)
2 Lanes
11 Ft Travel Lanes
10' Turn Lanes, As Warranted
5' Bicycle Lane (4' Min)
8' Parking
8' Planting Strip (not to scale)
10' Min. Sidewalk
49' between Back-of-Curb sections

RESIDENTIAL/SUBDIVISION STREET

Local: 25 MPH

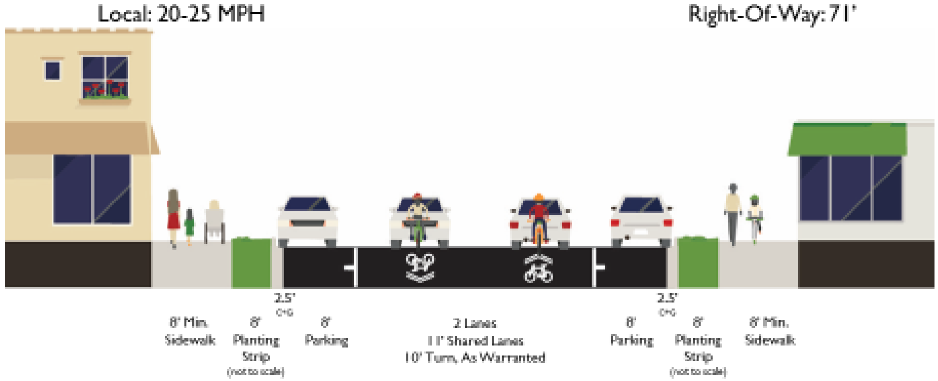
Right-Of-Way: 45'

27' between Back-of-Curb sections (Min Width)
Includes Parking, Curb, and Gutter.

COMMERCIAL STREET

Local: 20-25 MPH

Right-Of-Way: 71'



39' between Back-of-Curb sections

Guidelines for Complete Street Installation (*When the appropriate typical street cross-section cannot be constructed due to physical or right-of-way constraints the following procedure shall be followed for the Town staff to provide a street recommendation.)*

The purpose of this section is to explain how the perspectives of stakeholders interested in or affected by existing or future streets will be incorporated into a process for planning and designing streets in the Town of Chapel Hill. The process is modeled after a planning program for Charlotte's Sphere of Influence. The process described in this section consolidates traffic engineering, traditional city planning, urban design, and transportation planning activities into a sequence of decision-making steps.

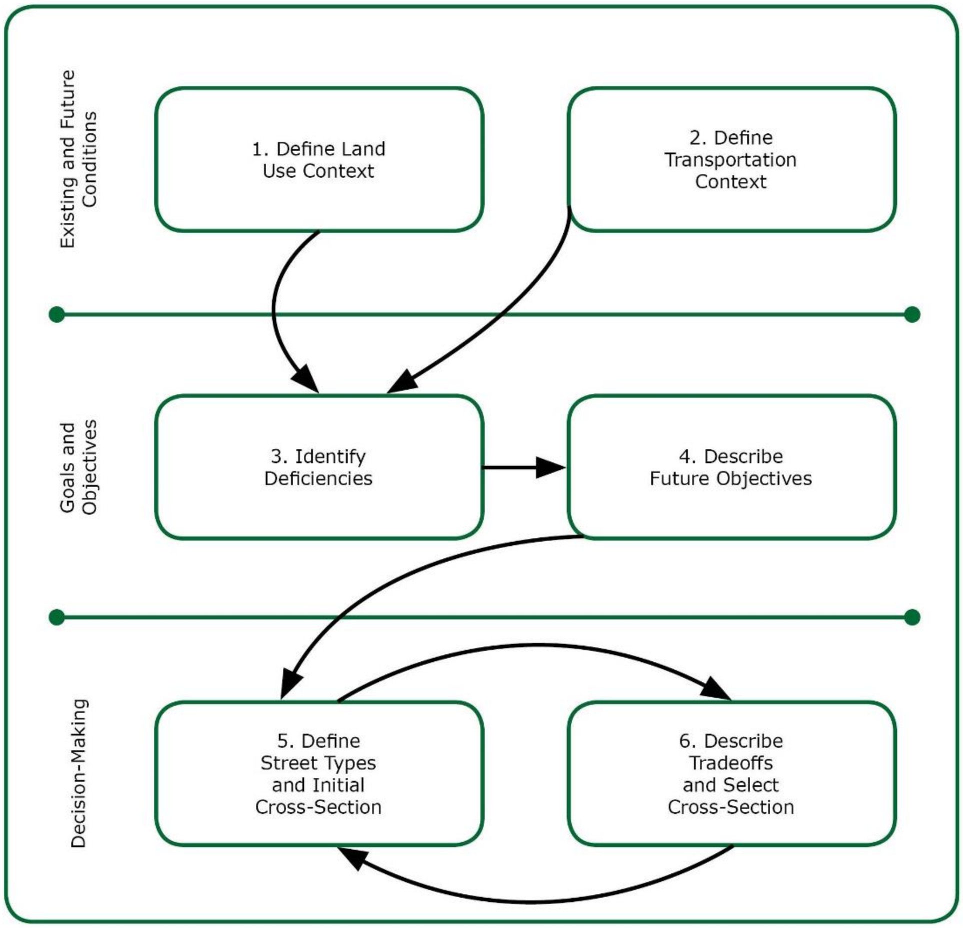
The application of this process for planning and designing streets is intended to support the creation of "more streets for more people” this goal will require the following procedure:

1. Ensuring the perspectives of all stakeholders interested or affected by streets are considered during the planning and design process for existing or future streets;
2. Defining a clear sequence of activities to be undertaken by staff, consultants and other stakeholders*(See Figure 3.1)
3. Keeping in mind this process is geared toward what we want to happen in the future than just accepting what happened in the past or exists now;
4. Verifying the inevitable tradeoffs affecting objectives, benefits, costs, and impacts are well documented so the recommendations made by staff, are based on understanding the direct effects on specific modes of travel and/or land use intentions; and
5. Always trying to create more complete streets for all modes of travel, which are noteworthy because of the very effective ways which the adjacent land uses and transportation functions of those streets support each other.

The process described in this section provides flexibility to those involved in the decision-making process, to ensure the resulting streets are appropriately based on the existing and proposed land use and transportation contexts.

*The stakeholders involved in the preliminary recommendation are: Town of Chapel Hill staff (Public Works Department, Planning and Sustainability Department), property owners abutting the street, and the developer. The public at-large will be provided opportunities to weigh-in during the public hearing process, when applicable.

Figure 3.1 - Six Step Process for Applying Street Design Guidelines



Source: City of Charlotte

The six-step process shown above and described below will primarily be applied to planning and designing the "non-local" street types - Boulevards, Parkways, Main Streets, Avenues.

Step 1: Define the Existing and Future Land Use and Urban Design Context

The classification and ultimate design of any street should reflect both the existing and expected future land use contexts.

- What does the area look like today?
- What are todays land use mixtures and densities?
- What are the typical building types, their scale, setbacks, urban design characteristics, relation to street, any special amenities, etc.?
- Are there any particular development pressures on the area (the nature of this may vary according to whether the area is a "greenfield" versus an infill area and this type of information is particularly important in the absence of an area plan)? What, if anything,

can be gleaned from permit data, for example, about the nature of the emerging land use context?
- What are the "functions" and the general circulation framework of the neighborhood and adjacent areas?
- Is there a detailed plan for the area?
- If so, what does the adopted, detailed plan envision for the future of the area?
- Does the plan make specific recommendations regarding densities, setbacks, urban design, etc.?
- Are there any other adopted development policies for the area?
- If so, what do those policies imply for the area?

Step 2: Define the Existing and Future Transportation Context

The transportation assessment should consider both the existing and expected future conditions of the transportation network. The following questions should be addressed by the design team:

- What is the character of the existing street? How does the street currently relate to the adjacent land uses?
- How does the street currently function? What are the daily and hourly traffic volumes? Operating and posted speeds? What is the level-of-service (LOS) for pedestrians? Cyclists? Motorists?
- What are the current design features, including number of lanes, sidewalk availability, bicycle facilities, traffic control features, street trees, etc.?
- What, if any, transit services are provided? Where are the transit stops?
- What is the relationship between the street segment being analyzed and the surrounding network?
- Are there any programmed or planned transportation projects in the area which may affect the classification of the street segment?
- Are there any other adopted transportation policies which may affect the classification of the street segment?

Step 3: Identify Deficiencies

Once the existing and future land use and transportation contexts are clearly defined and understood from an area-wide perspective, the design team should be able to identify and describe any deficiencies which could/should be addressed by the new or modified street.

Deficiencies might include, but are not limited to:
- Gaps in the bicycle or pedestrian network near of along the street segment;
- Insufficient pedestrian or bicycle facilities
- Gaps in the overall street network (this includes the amount of connectivity in the area, as well as any obvious capacity issues on other segments in the area);
- Inconsistencies between the amount or type of transit service provided along the street segment and the types of facilities and/or land uses adjacent to the street;
- Inconsistencies between the existing land uses and the features of the existing or planned street network.

Step 4: Describe Future Objectives

This step synthesizes the information from the previous steps into defined objectives for the street project. The objectives will form the basis for the street classification and design.

In addition to the general intent of providing complete streets, the following issues should be considered in defining specific objectives:

- What conditions are expected to stay the same (or, more importantly, what conditions should stay the same)?
- Would the community and the stakeholders like the street and neighborhood to stay the same or change?
- Why and how would the community and stakeholders like the street and neighborhood to change?

Step 5: Recommend Street Classification and Test Initial Cross-Section

The initial cross-section should be tested against the land use and transportation contexts and the defined objectives for the street project. Any constraints to the provision of the initial, preferred cross-section should also be identified, including:

- Lack of right-of-way,
- Existing structures,
- Existing trees or other environmental features,
- Topography, and
- Location and number of driveways.

This step should also include a recommendation for any necessary adjustments to the land use plan/policy and/or transportation plan for the specific area.

Step 6: Describe Tradeoffs and Select Cross-Section

If the initial, "preferred" cross-section can be applied, then this step is easy: the initial cross-section is the recommended cross-section. In many cases, though, the initial cross-section will need to be refined to better address the land use-and transportation objectives, given the constraints identified in Step 5. Sometimes, the technical team will develop more than one alternative design. In this case, the multiple alternatives should be presented to the stakeholders.

Any refinements to the initial cross- section (or alternatives) should result from a thoughtful consideration of tradeoffs among competing uses of the existing or future public right-of - way. The tradeoffs should be related to the requirements of each group of stakeholders and the variety of design elements which can best accommodate those requirements.

Once the tradeoffs are evaluated, the team should be able to develop a refined cross-section and suggested design treatments. The culmination of all of the previous steps, including any additional stakeholder comments, should provide sufficient rationale to select the design alternative which best matches the context and future expectations for the street project.

Final Comments on the Six Steps

The steps outlined in this section suggest there is a linear process leading to an ideal solution. Realistically, in some instances the process may not follow the exact sequence described above. Some information may not be available or even be applicable for some conditions. The intent, though, is to ensure the existing and future contexts are given adequate consideration, any related plans are modified to reflect the outcome, and all perspectives are considered.

Appropriate Speed - Local streets should be designed to discourage excessive vehicular speeds. Traffic calming techniques are encouraged where warranted by conditions. Traffic calming is a broad term representing a variety of measures which can be implemented to create safer streets by improving conditions for pedestrians and bicyclists. The Institute of Transportation Engineers defines traffic calming as “the combination of mainly physical measures which reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for non-motorized street users” (ITE Journal, July 1997).

Traffic calming measures accomplish this by:

1. Slowing the speed of motor vehicles
2. Reducing collision speed and severity
3. Improving safety for non-motorized users of the street
4. Enhancing the street environment
5. Increasing access for all modes of transportation
6. Reducing cut-through motor vehicle traffic

The primary methods for accomplishing these objectives are through speed control measures. Other methods include increasing public education and awareness through traffic safety campaigns, police enforcement, and street parking. Volume control measures also exist but should be considered extraordinary measures used under strictly limited and specifically defined circumstances.

3.3 TRAFFIC CONTROL DEVICES

Where warranted and as necessary for motorist, bicyclist, and/or pedestrian traffic control; traffic signals, signs, and markings shall be provided in accordance with the standards set forth in the latest version of the Manual on Uniform Traffic Control Devices for Streets and Highways. Installation of all traffic control devices shall be approved by the Town Manager and the North Carolina Department of Transportation where applicable.

Traffic Calming Policy (2016) and Procedures

Traffic calming measures are applicable in residential neighborhoods where speeding vehicles and/or cut-through traffic are the primary concerns, and traditional police enforcement is found to be unfeasible and/or ineffective. Streets must typically be residential in nature for consideration under this policy. The policy is intended to promote traffic calming measures which are appropriately implemented, coordinated with the Town’s key departments including Police, Fire, Engineering and Transit, and are supported by the community. In addition to citizen requests, traffic calming projects can also be identified by Town staff, Town Advisory Boards, and/or the Town Council.

The Staff will identify improvements to the procedures to keep the implementation of the Council’s policy up-to-date. Staff will report on the status of the procedures during the annual update on the Town’s Traffic Calming Program.

The following procedure(s) will be used to identify, evaluate, and implement traffic calming projects in Chapel Hill:

1. A citizen requesting traffic calming improvements will fill out a Request for Traffic Calming Measures form available in the Town Public Works Department and on the Town web site (See Appendix A).

2. Upon receipt of a properly completed request form, the Town's Transportation Management Team will review the initial request to make sure the requested streets for traffic calming measures do not reduce response time for emergency service providers. The Public Works Department will determine an applicable "service area" surrounding the requested traffic calming site(s) and will provide the requesting citizen with a Petition form (See Appendix A) to be signed by interested property owners within the designated service area. The size and extent of the service area will take into consideration the type of traffic calming project being proposed, the layout and type of properties in the vicinity, and the characteristics of the street network surrounding the proposed project site(s). Depending on the circumstances, the service area may include:
   - All properties abutting the proposed street segment to be modified.
   - All properties on adjacent street(s) with ingress/egress only possible via the modified street segment.
   - All properties on adjacent street(s) having alternative points of ingress/egress but will be otherwise affected by the modified street segment.

   The Transportation and Connectivity Advisory Board will hear appeals regarding service area boundaries established by Town staff, and will provide recommendations regarding alterations of the boundaries for consideration by the Manager.

3. The Public Works Department will prepare a Petition form including the following items:
   - A map showing the service area
   - A listing of property owners in the service area
   - A preliminary traffic calming plan showing probable devices and their locations

   The requesting citizen will obtain signatures on the Petition form. A valid Petition for Traffic Calming Measures must be signed by two-thirds of the property owners within the service area surrounding the requested traffic calming site(s).

4. The requesting citizen will return the Petition form, with **original** signatures, to the Public Works Department at 6850 Millhouse Road, Chapel Hill, N.C. 27516. Email signed petitions from the property owners are also allowed in lieu of original signatures. The email petition must indicate the full name(s) of property owners. Email signed petitions must be returned to the email address traffic@townofchapelhill.org.

5. The Public Works Department will confirm the Petition signatures concur with land ownership records. Once a Petition is determined to be valid, the Public Works Department will notify the requesting citizen of the petition status.

6. Upon receipt of a valid Petition (as described in Step #3 above), the Public Works Department will gather project site data including traffic volumes, speeds, and accident history. A proposed project plan will be developed using the following procedure:
   - Assess problems and needs

- Identify goals and objectives
- Identify evaluation criteria
- Evaluate alternatives
- Select a proposed plan

The development of a traffic calming plan will include review and evaluation by the Town Fire Department, the Town Police Department, the Town's Transportation Management Team, neighborhood meetings, citizen input, consideration of current Town Policy for Placement of Stop Signs and Assignment of Speed Limits, and evaluation of the types and design criteria of traffic calming measures applicable to site.

The Public Works Department will prepare a cost estimate for the proposed traffic calming project and associated improvements.

7. Traffic calming projects will be prioritized in accordance with the ranking system outlined in the Policy, and will be presented to the Town Transportation and Connectivity Advisory Board for consideration. The Board will review the proposed projects, including the associated traffic data compiled for each project. Based on its review, the Board will provide recommendations to be included with the Town Manager's annual report to the Town Council regarding proposed traffic calming projects

8. In the fall of each year, the Town Manager will prepare and present to the Council a report regarding proposed traffic calming projects. This report will include:

   - A prioritized list of proposed traffic calming projects
   - A summary of the traffic data pertaining to each project
   - Transportation Board review comments and recommendations
   - The Town Manager's recommendations

   The Council will receive the Manager's report and recommendations, and may approve projects or refer them for further consideration during annual budget deliberations.

9. If necessary, during the budget development process, the Council will consider the proposed traffic calming projects presented in the Manager's annual report, and will allocate funds for construction as it deems appropriate.

10. Once project funding is approved by the Council, the Public Works Department will prepare construction plans and specifications and an updated cost estimate.

11. When the final project drawings are complete, the Public Works Department will schedule a neighborhood meeting to discuss the plans, estimated costs, and construction procedures/schedule. Each property owner in the service area of the project will be notified when and where the meeting is scheduled.

12. The project will be constructed by Town forces or by private contractor.

13. Town staff will monitor the performance of completed traffic management projects, and will report to the Council and Transportation and Connectivity Board regarding the operation and effectiveness of the traffic calming measures within 12-18 months following

installation. This follow-up report could result in Council action to revise or remove a previously approved traffic management measure.

14. Citizen requests for removal of traffic calming devices will be required to go through the same petition process described previously for installation requests.

Table 3.3 – Types of Traffic Calming Measures and Design Criteria

Traffic Calming Device	Street Classification (Intersection)	Average Daily Traffic Volume (ADT) Minimum & Maximum	Street Width (Edge to Edge)	Street Grade or Intersecting Street Grades	Line of Sight (Minimum)	Adjacent On-Street Parking	Posted Speed Limit	Minimum 85th Percentile Speed
Speed Tables	Local or Local Collector	800 - 3000 vpd	25 ft.	4%	360 ft.	Removed	25 mph	35 mph
Pavement Treatments	Local or Local Collector	800 - 3000 vpd	20 ft.	4%	360 ft.	Removed	25 - 35 mph	35 to 45 mph
Semi-Diverters	Local	800 - 1500 vpd	25 ft.	1%	360 ft.	Removed	25 mph	35 mph
Cul-de-sac	Local	800 - 1500 vpd	(Note 1)	(Note 2)	360 ft.	Removed	25 mph	35 mph
Mid-block Closure	Local	800 - 1500 vpd	25 ft.	(Note 2)	360 ft.	Removed	25 mph	35 mph
Forced Turn Channelization	Major Street - Local or Local Collector Minor Street - Local	800 - 1000 vpd	25 ft.	(Note 1)	360 ft.	Removed	25 - 35 mph	35 to 45 mph
Traffic Circle	Major Street - Local or Local Collector Minor Street - Local	800 - 3000 vpd	(Note 1)	1%	360 ft.	Removed	25 - 35 mph	35 to 45 mph
Chicanes	Local Collector	800 - 3000 vpd	(Note 1)	4%	360 ft.	Removed	25 - 35 mph	35 to 45 mph
Chokers	Local or Local Collector	800 - 3000 vpd	(Note 1)	4%	360 ft.	Removed	25 - 35 mph	35 to 45 mph

Note 1: Existing Street conditions must be able to accommodate Emergency vehicle requirements.
Note 2: Existing Street conditions must be able to maintain drainage requirements.
Note 3: The criteria in this table were developed by the Chapel Hill Public Works Department. They are based on accepted traffic engineering practices and similar traffic calming applications in other parts of the country.

Stopping Sight Distance and Sight Line Triangles at Intersections
Sight line triangles at intersections should be designed to assure adequate visibility for vehicles and pedestrians using the intersection. Signs, trees, shrubs, etc. should not interfere with these sight lines. The developer shall dedicate sight line easements as necessary.

The following table has been adopted from the American Association of State Highway and Transportation Officials (AASHTO) "A Policy on Geometric Design of Highways and Streets":

Where there are sight obstructions (such as walls, cut slopes, buildings and other hazards) on the inside of curves, changes in roadway alignment may be required to obtain adequate stopping sight distance if the sight obstructions cannot be removed.

Table 3.4 - Design Intersections Sight Distance Table

Design Speed (mph)	Stopping Sight Distance (ft)	Intersection Sight Distance for Passenger Cars	
		Calculated (ft)	Design (ft)
15	80	165.4	170
20	115	220.5	225
25	155	275.6	280
30	200	330.8	335
35	250	385.9	390
40	305	441.0	445
45	360	496.1	500
50	425	551.3	555
55	495	606.4	610
Intersection sight distance shown is for a stopped passenger car to turn left onto a two-lane highway with no median and grades 3 percent or less. For further conditions, the time gap should be adjusted and the sight distance recalculated.			

Turn Lane Warrants

Additional pavement surfaces to accommodate turning movements shall be required and constructed at intersections to the standards specified below for projects not required to have a traffic impact analysis.

Table 3.5 - Left Turn Lane Warrants for Two-lane Roadways

Opposing Volume (veh./hr.)	*Advancing Volume (veh./hr.)*			
	5% Left Turns	*10% Left Turns*	*20% Left Turns*	*30% Left Turns*
40-mph Operating Speed				
800	330	240	180	160
600	410	305	225	200
400	510	380	275	245
200	640	470	350	305
100	720	515	390	340
50-mph Operating Speed				
800	280	210	165	135
600	350	260	195	170
400	430	320	240	210
200	550	400	300	270
100	615	445	335	295
60-mph Operating Speed				
800	230	170	125	115
600	290	210	160	140
400	365	270	200	175
200	450	330	250	215
100	505	370	275	240

Note: For operating speeds not shown, interpret between given values.

Source: City of Raleigh Design Manual

Dead-End Streets

Maximum length shall be no greater than 750 feet or no more than thirty-five (35) dwelling units. Streets designed to be permanently dead-end shall terminate in a paved circular turnaround (cul-de-sac) with a minimum radius of forty-eight (48) feet measured from the center of the turnaround to the face of the curb. Streets designed to be dead-end temporarily (such as in a phased development or where a street is to be extended) can terminate in a paved circular turnaround or a paved "T" turnaround of adequate size to accommodate emergency vehicles which may use the street. Under special circumstances, a 120 foot "T" turnaround may be acceptable as a permanent improvement. Refer to the latest edition of the North Carolina Fire Prevention Code.

A separate, post mounted “Dead End” sign shall be placed at the closest intersection to the dead end. Also, temporary dead end streets expected to be extended in the future shall include a sign located at the temporary dead end stating “This Roadway is Subject to Future Extension”.

Pavement Structural Standards
All streets shall be paved with a minimum structure shown in Table 3.6 or Table 3.7 below or an equivalent design as approved by the Town Manager.

For all public streets, the developer will be required to submit a detailed soils report prepared by a soils engineer, licensed in North Carolina, to establish the suitability of the existing soils for roadway construction. This requirement may be waived if the Town Engineering Inspector's site investigation indicates normal compaction tests would sufficiently guarantee road base suitability.

Based on the results of soils investigations, previously observed conditions, and/or conditions encountered in the field; additional requirements for street construction may include increased pavement and/or base thickness, dewatering drain systems, excavation of unsuitable materials, installation of geotextile materials, and other enhancements as may be deemed necessary to assure streets will not experience premature failure.

The use of the curb and gutter section for street development has been determined to require the least amount of grading, clearing, right-of-way, and maintenance of all alternative roadway sections. Therefore, to preserve the natural environment and to minimize erosion and sedimentation, the Town will typically require the use of curb and gutter roadway section except as noted in the paragraph below.

In areas where poor subsoil drainage and periodic flooding is determined to be a problem by the Town Manager, or in established neighborhoods without curb and gutter streets, the developer may be required to use a roadside swale-type street construction. If curb and gutter is deleted, additional right of way may be required. The design of the swales shall prevent significant erosion which may occur from a ten (10) year storm rate of discharge. Shoulders on arterials shall be paved. On all other roads, shoulders shall be constructed of at least 50 percent gravel and at most 50 percent soil material.

In the event the soil report and/or site investigation indicates roadway construction requirements different from the standards described above, the Town Manager may require the alternative roadway construction design(s) be submitted for approval by the Chapel Hill Public Works Department.

Table 3.6 – Pavement Design for Good to Excellent Subgrade Soils*

Functional Classification	Base Stone*	Intermediate Asphalt Course	Surface Asphalt Course
Local Street	ABC compacted to 8"	2 ½" I-19B	1" SF 9.5A
Collector/Arterial Street	ABC compacted to 10"	3" – I19	2" S 9.5B

Table 3.7 – Pavement Design for Poor to Fair Subgrade Soils*

Functional Classification	Base Stone*	Intermediate Asphalt Course	Surface Asphalt Course
Local Street	ABC compacted to 10”	2 ½” I-19B	1” SF 9.5A
Collector/Arterial Street	ABC compacted to 10”	3” I-19B	2” S 9.5B

* Soil types are as defined in the North Carolina Department of Transportation Subdivision Roads Manual

Phased Completion of Streets

The developer shall synchronize the probable completion of houses or other building construction with the completion of utilities, fire hydrants, and streets serving those buildings. The intent is to prevent unreasonable inconvenience to the building occupants from dust, mud, or hazardous conditions and also to avoid unsightly appearance along the access to these buildings.

Therefore, the developer shall complete at a minimum the base course paving of all streets within the development within one year of recording the final plat. If the developer believes for certain reasons his development will take more than one year to "build out" then he should record the final plat for only the phase expected to be completed within one year. The Town Manager may extend this deadline.

Any street failures which occur within the one year warranty period after acceptance of the street by the Town shall be repaired by the developer.

3.4 TRAFFIC IMPACT STUDIES

The Town of Chapel Hill considers the traffic impacts of proposed new development during its review process (except for projects located in the Ephesus Fordham District where a district-wide TIA is in effect). Therefore, the preparation of a traffic impact analysis is typically required to quantify impacts of the proposed development and to identify facility improvements needed to maintain acceptable level of service standards. The developer should coordinate with the Town Traffic Engineer to engage a Town consultant to perform all required TIAs. Under the following circumstances, a traffic impact analysis is typically required:

1. Submittal of a development proposal requesting a change in zoning.
2. Submittal of an application for a major subdivision, special use permit, or site plan review. Typically, a full traffic impact analysis as detailed herein is required for all these development requests. The requirement to prepare a full traffic impact analysis (TIA) may be waived by the Town Manager only if all of the following conditions are met:
    a. Daily trip generation is less than 500 (or, for a change to an existing property which does not require rezoning, difference in daily trip generation is less than 500); and
    b. No more than 250 vehicles per day (or, for a change to an existing property not requiring rezoning, no more than 250 vehicles per day difference) access an existing collector or local road; and

c. The total traffic, including background traffic and additional traffic from proposed new site or redeveloped property does not exceed an average of 150 vehicles per day on any unpaved road; and
d. The applicant submits a written request for a Traffic Impact Analysis waiver with appropriate supporting documentation including pedestrian/bicycle analysis, if applicable; and
e. The Town Manager concurs with the request.

When elapsed time or circumstances of the original analysis fall within the parameters presented in the following table, the applicant shall prepare an updated or amended analysis with documentation according to the following specific requirements.

Long Term Analysis may also be waived by the Town Manager based on the site and type of the development. For additional information refer to:

Guidelines for Traffic Impact Analysis, Town of Chapel Hill, North Carolina Effective Date: October 1, 2001

	Changes to the Original Proposed Development	
Original Report Is	Access Changed* or Trip Generation Increased by > 15%	Access Not Changed and Trip Generation Increased by < 15%
Less than 2 Years Old	Letter Amendment Required: Identify and discuss only items which changed.	Letter Documenting Change (No other reports required)
Greater than 2 Years Old or Study Prepared Prior to TIA Guidelines Approval	New Study	Letter Amendment Required: 1. New local ground counts. 2. New Trip Generation 3. New LOS Analysis 4. Meet all current requirements of this TIA Guideline

*Changed access includes proposed new access or refinement of general access locations not specifically addressed in original proposed development.

3.5 STREET NAMES AND ADDRESSES

Names of streets shall reflect the continuity of streets (i.e., a proposed street in obvious alignment with an existing street or planned as a continuation of an existing street be given the same name as the existing street) and shall be neither wholly nor partially duplicative nor phonetically similar to the name of an existing street within the Town of Chapel Hill.

For approval of new street names and addresses contact the Planning and Sustainability Department (919.969.5066) at least two (2) weeks prior to the submittal of a final plat for recordation.

3.6 TRANSIT AMENITIES

Transit amenities including bike parking, lanes and paths, bus shelters and pull-offs, benches, walkways, pull-offs, etc. will be required for areas to be served by the transit system.

The Town will determine which amenities will be required and where they will be located, based upon transit routes, street classifications, types of development, passenger volumes, and any other pertinent considerations on a case-by-case basis. However, bus pull-offs may be required at bus stops on Collector and Arterial streets as determined by the Town.

Bus Pullouts

Well placed, carefully designed bus pull-outs offer safe passenger loading and unloading with minimal delays to both transit and other roadway traffic. While serving as a bus stop, they may also be used simultaneously as a schedule layover area.

Multi-lane, one-way streets may have sufficient gaps in the traffic stream to allow all other traffic to pass around a stopped bus. Bus pullouts are generally not appropriate on these roadways.

When a bus pullout is required, it should be placed to allow buses to easily re-enter the traffic flow. The design of a bus pullout should allow through vehicle and bicycle traffic to flow freely without the obstruction of stopped buses. They should generally be placed on the far-side of a signalized intersection so the signal can create gaps in traffic. The pullout length should be increased by 50 feet for each additional single unit bus expected to concurrently use the pullout. Due to the highly concentrated loadings, bus pullouts should generally be constructed of plain doweled concrete pavement.

Figure 3.2 - Chapel Hill Transit Bus at Pullout

The following factors should be considered when deciding to incorporate bus pullouts in a design:

1. Buses are expected to layover at the end of a route; or, bus routes intersect and buses have extended stops to allow for transfers.
2. Traffic in the curb lane exceeds 250 vehicles during the peak hour.
3. Posted traffic speed is 35 MPH or greater.
4. Bus volumes are ten or more per peak hour on the roadway.
5. Passenger volumes exceed 20 to 40 boarding's per hour per bus.
6. Average peak-period dwell time exceeds 30 seconds per bus.
7. History of repeated traffic and/or pedestrian crashes at stop location.
8. Right-of-way width is adequate to construct the pullout without adversely affecting sidewalk pedestrian movement.
9. Improvements, such as widening, are planned for a major roadway so the expansion provides an opportunity to incorporate the bus pullout as part of the improvement.

Bus Shelters

Bus shelters not only provide protection from the elements, they can improve the flow of pedestrian traffic by concentrating waiting passengers in one small area of the right-of-way. At the same time, however, bus shelters can disrupt the streetscape and use a disproportionately large area of the sidewalk, leaving limited space for pedestrians. While the approximate location of bus shelters on the street must always be based upon the safety of passengers and operative feasibility for the bus drivers, the specific placement should always consider the desired typical section of the Street Design Guidelines. Shelters should be placed either as close to the curb as possible or abutting the right-of-way edge to allow for the maximum use of the sidewalk and right-of-way.

Bus shelters can be of many different designs including public art projects. The designs of shelters should take into consideration the relationship between the accessibility for passengers and the use of the street by pedestrians and cyclists.

3.7 BICYCLE AND MULTI-USE FACILITIES

Bicycle Parking

Classification of Bicycle Parking

Long-term parking includes indoor secured bicycle parking spaces with a locker, individually locked enclosure, or supervised area within a building providing protection for bicycles from theft, vandalism and weather.

Short-term parking includes an open air, stationary rack to which a bicycle can be secured with a lock, cable or chain. Racks must be easily usable with both u-locks and cable locks. Racks which support a bicycle primarily by a wheel only and not the frame, such as typical "disk racks," are damaging to wheels and are not acceptable. Table 3.8 provides general guideline:

Location and Design of Bicycle Parking Areas.

1. Parking facilities shall support bicycles in a stable position without damage to wheels, frame or components, so the bicycle, if bumped, will not fall or roll down.
2. Parking facilities shall be securely anchored to the lot surface so they cannot easily be removed and shall be of sufficient strength to resist vandalism and theft.
3. Parking should be located in close proximity to the building's entrance.
4. Parking facilities should be located in highly visible well-lighted areas to minimize theft and vandalism.
5. Bicycle parking facilities shall not impede pedestrian or vehicular circulation, and should be harmonious with their environment both in color and design. Parking facilities should be incorporated whenever possible into building design or street furniture.
6. Each bicycle parking space shall be at least six feet long by two feet wide. Racks must not be placed close enough to a wall or other obstruction so as to make use difficult. There must be at least 24 inches beside each parked bicycle to slow access. Adjacent bicycles may share this access. An aisle or other space shall be provided for bicycles to enter and leave the facility. This aisle shall have a width of at least six feet to the front or rear of a bicycle parked in the facility.
7. Paving is preferred, not required. Well-draining gravel is the minimum surface treatment in order to avoid mud and dust.

8. Bicycle parking facilities within auto parking areas shall be separated by a physical barrier such as curbs, wheel stops, poles or other similar features to protect bicycles from damage by cars.
9. Ideally, bicycle parking should be under cover to protect bicycles from damaging sun and foul weather.

Table 3.8 – Bicycle Parking Spaces Required by Use

USE	Minimum Bike Parking Requirements	Short Term	Long Term
Automobile, trailer, and	N/A	N/A	N/A
Bank	Min 4; 2 additional spaces per every 2,500 sq. ft. of floor area	80%	20%
Business, Convenience Restaurant	Min 4; 2 additional spaces per every 1,000 sq. ft. of floor area	80%	20%
Other convenience business	Min 4; 2 additional spaces per every 2,500 sq. ft. of floor area	80%	20%
Business, general (retail)	Under 100,000 sq. ft. floor area: Min 4; 2 additional spaces per every 2,500 sq. ft. of floor area for 1st 10,000 sq. ft.; then 1 additional space per 5,000 sq. ft.; Over 100,000 sq. ft. floor area: 1 space per 10,000 sq. ft. floor area	80%	20%
Business, office-type	Min 4; 2 additional spaces per every 2,500 sq. ft. of floor area	80%	20%
Clinic	Min 4; 2 additional spaces per every 2,500 sq. ft. of floor area	20%	80%
Dwelling, single-family	N/A	N/A	N/A
Dwelling/Duplex or multi-family	1 per 4 dwelling units		
Efficiency		10%	90%
1 bedrooms		10%	90%
2 bedrooms		10%	90%
3 bedrooms		10%	90%
4 or more bedrooms		10%	90%
Fraternity or sorority	Min 4; 1 per 3 residents	10%	90%
Group Care Facility	Min 4; 1 per 4 beds	10%	90%
Hospital	Min 8; 1 per 10 beds	20%	80%
Hotel or motel	Min 8; 1 per 15 lodging units	80%	20%
Maintenance and/or	Min 4	20%	80%
Manufacturing, light	Min 4	20%	80%
Mobile home park	N/A	N/A	N/A
Movie Theatre	Min 8; 1 per 50 seats	80%	20%
Personal services	Min 4; 2 additional spaces per every 2,500 sq. ft. of floor area	80%	20%
Place of assembly	Min 8; 1 per 40 seats	20%	80%
Place of worship	Min 8; 1 per 50 seats	80%	20%
Public cultural facility	Min 8; 2 additional spaces per every 5,000 sq. ft. of floor area	80%	20%
Public use facility	Min 8; 2 additional spaces per every 4,000 sq. ft. of floor area	80%	20%
Research activities	Min 4; 2 additional spaces per every 4,000 sq. ft. of floor area	20%	80%
Residence hall	Min 4; 1 per 2 residents	90%	10%
Residential support facility	Min 4; 2 additional spaces per every 5,000 sq. ft. of floor area	10%	90%
Rooming house	Min 4; 1 per 3 lodging units	10%	90%
School, elementary,	Min 8; 1 per 10 students	90%	10%
School, secondary, high	Min 8; 1 per 10 students	90%	10%
Shelter	Min 4; 1 per 10 employees	10%	90%
Tourist home	Min 4; 1 per 3 lodging units	80%	20%

Multi-Use Paths

A multi-use path is a bike/pedestrian way physically separated from motorized vehicular traffic by an open space or barrier and within the street right-of-way, an independent right-of-way or an easement. Multi-use paths provide recreational opportunities and serve as extensions of the transportation system. The designer must use accepted design criteria to provide a safe multi-modal facility. Refer to the American Association of State Highway and Transportation Officials Guide for the Development of Bicycle Facilities, 4th Edition manual for additional information on multi-use trail design.

Width and Clearance – The minimum paved width for all two directional bicycle paths is ten (10) feet. In some cases, it may be necessary to increase the width of the path due to a significant number of pedestrians using the path; or when the path is designed with a horizontal radius less than 95 feet. For horizontal clearance purposes, a minimum of three (3) foot wide graded shoulder must be provided on both sides of the pavement. The minimum vertical clearance should be eight (8) feet. However, a greater clearance may be needed for tunnels.

Grades – Grades greater than 5 percent are undesirable. If, due to the terrain or other considerations, the installation of a 5 percent or flatter grade is shown to be impractical, then a steeper grade may be used for short distances if approved by the Town.

Wayfinding Signage and Marking System - Refer to the American Association of State Highway and Transportation Officials Guide for the Development of Bicycle Facilities, 4th Edition, Section 5.4 – 5.4.3 Pavement Markings, Signs, and Signals, for guidance on the development of a multi-use path wayfinding and marking system.

The Shared-Use Path Restriction sign may be installed to supplement a solid white/yellow pavement marking line on facilities which are to be shared by pedestrians and bicyclists in order to provide a separate designated pavement area for each mode of travel. The symbols may be switched as appropriate.

Figure 3.3 - Shared-Use Path Restriction Sign

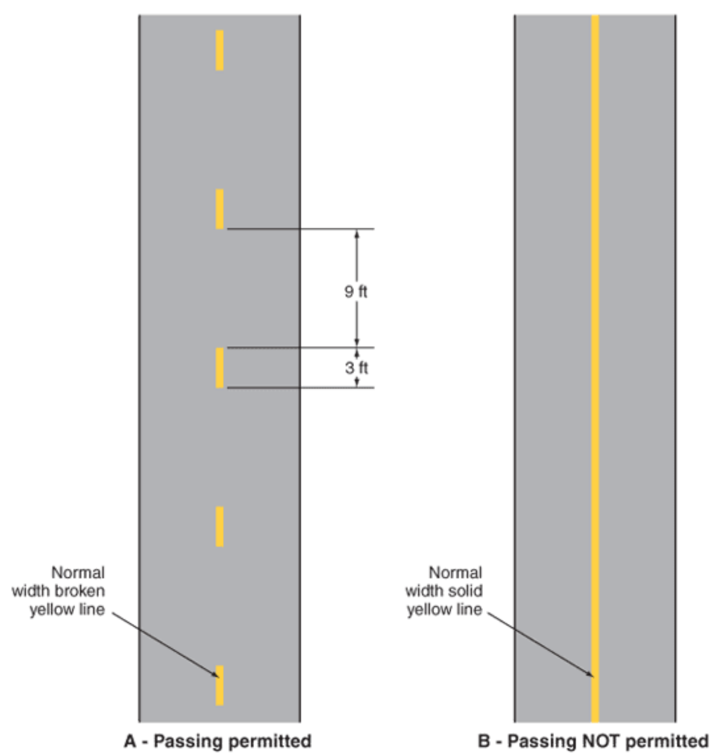
Guidance

In cases where two-way operation is permitted on the facility for pedestrians and/or bicyclists, the designated pavement area which is provided for each two-way mode of travel should be wide enough to accommodate both directions of travel for each mode.

Option

In cases where shared-use paths are of sufficient width to designate two minimum width lanes, a solid yellow line may be used to separate the two directions of travel where passing is not permitted. A broken yellow line may be used where passing is permitted, see Figure 3.4.

Figure 3.4 - Examples of Center Line Markings for Shared-Use Paths



Design Speed – The typical design speed for a bicycle path is 20 mph. When the grade exceeds 4 percent, a design speed of 30 mph is advisable

Horizontal Alignment – The typical cross slope is 2 percent for tangent sections. The minimum design radius of curvature shall be derived from the following list:

20 mph……...95 feet radius
25 mph…….155 feet radius
30 mph…….250 feet radius
35 mph…….390 feet radius

Pavement Design – A hard, all-weather pavement shall be used. A geotechnical report shall be provided by a licensed engineer with a recommendation for a pavement design suitable for bicycles and maintenance vehicles.

Bicycle Lane

A bicycle lane is a portion of a street which has been designated by signs and pavement markings for the exclusive use of bicyclists. Bicycle lanes are typically one-way facilities which carry bicycle traffic in the same direction as adjacent motor vehicle traffic.

Width and Clearance – Five-foot width is standard. Four-foot width may be approved based on site constraints. However, greater width may be required with the presence of on-street parking, narrow lanes for motorized vehicles, unsuitable curb-and-gutter conditions, or high volumes of truck traffic. See Town of Chapel Hill Bike Plan for further discussion of bike lane requirements.

Pavement Design - The surface shall be smooth with a uniform riding surface. For maintenance reasons the bicycle lane should be constructed to the same standards as the adjacent traffic lane.

Disability Access

All public pedestrian facilities shall, to the extent practicable, be continuous and accessible to physically disabled users. Such facilities should be designed to reasonably accommodate users with physical disabilities who require the use of walkers, wheelchairs, scooters, or other such supplemental mobility devices. Pedestrian facilities shall be designed to not include slopes in excess of 1:12 unless flat rest areas are included between steeper segments.

Intersections between motorized vehicle ways and pedestrian ways shall be at grade or connected by means of a ramp with a slope no steeper than 1:12. Ramps and segments of pedestrian ways at intersections shall include detectable warnings in accordance with the requirements of the Americans with Disabilities Act.

3.8 DESIGN GUIDELINES FOR THE VISUAL ENVIRONMENT

The Town of Chapel Hill endorses the standards, scope, and measurement of the National Institute of Building Sciences, Low Vision Design Program and expects designers to refer to the following information and incorporate into projects as appropriate:
http://c.ymcdn.com/sites/www.nibs.org/resource/resmgr/LVDC/LVDP_Guidelines_052815.pdf

Low Vision Design

While the following information isn't all related to "Streets, Parking & Transportation, it is germane to site development, adherence with ADA requirements, and is appropriate for inclusion in this Chapter:

Site Circulation – It is recommended that walkways in the public right-of-way comply with the following:

1. Walkways must not present hazards of tripping and falling due to uneven surfaces or from steps, curbs, and edging that are not clearly visible with change of color, value, and texture. Curbs and other walkway edges should be raised above the walkway pavement a minimum of 4 inches and be of contrasting color or value sufficient to be

clearly visible to the pedestrian as a pavement boundary. Pavement edge curbs are generally not needed when there are handrails.
2. The approach pathways to public entrances must be easily identified with signs or visual cues such as architectural or landscape features so that approaching persons will be able to locate the entrance.
3. Stairs and steps should be designed with leading edges (ie, nosings) that clearly contrast in color and value with treads and risers. Where steps cross grades, tapered risers to meet grade may be hazardous to the unwary pedestrian who may be unable to see the edge of the step and/or detect them visually or who may have balance issues. Where possible, tapering should be avoided or, in addition to contrasting edges, use handrails to lead or guide the pedestrian to the full step and riser section of the stairs/steps.
4. Pavement patterns and color changes that could be mistaken for steps should be avoided where they cross paths of pedestrian travel.
5. Drains and gratings should be placed to the sides rather than in the pathways in paved pedestrian areas. Gratings bars should run perpendicular to the path of travel and be spaced no more than ½ inches apart.
6. Avoid lighting placement that shines directly into pedestrians' eyes.
7. Walkway lighting should be provided to minimize glare. For example, bollard lighting should be directionally downward and overhead, and post lighting should baffled from view by walkers looking at the pathway.
8. Lighting directed toward the facades and other vertical surfaces of a building or facility is preferable to fixtures directed outward from the eaves, as often is done for security. Careful coordination of lighting is needed to avoid "blinding" closed circuit televisions (CCTV security cameras) on one hand and building occupants on the other, while providing desired building and landscaping lighting for aesthetic purposes.

Pedestrian Signals - United States Access Board Guidelines (2011)

Where pedestrian signals are provided at pedestrian street crossings, they shall include accessible pedestrian signals (APS) and pedestrian pushbuttons complying with sections 4E.08 through 4E.13 of the MUTCD (incorporated by reference, see R104.2). Operable parts shall comply with R403.

An accessible pedestrian signal and pedestrian pushbutton is an integrated device which communicates information about the WALK and DON'T WALK intervals at signalized intersections in non-visual formats (i.e., audible tones and vibrotactile surfaces) to pedestrians who are blind or have low vision. For improved pedestrian safety APS shall be installed at all signalized intersections with pedestrian amenities.

Pedestrian Signal Design Checklist

1. Proper Location: The functioning of a pushbutton-integrated APS is based on proximity to the crosswalk location. The closer the APS is located to the departure location, the quieter it can be. In addition, the vibrotactile indication and tactile arrow are not usable when located too far back from the street. Figure 3-5 illustrates installation recommendations (within five feet of the crosswalk extended, within ten feet of the curb, and separated by more than ten feet from other ASPs on the corner, adjacent to a level landing.
2. Audible tone indicating direction of crossing and "walk" or "don't walk" command.

   a. Volume which responds to ambient/background sounds to remain audible.
3. Accessible push buttons
   a. Locator tone
   b. Tactile arrow indicating direction of crossing
   c. Vibrotactile "walk" signal
4. Braille or verbal information about the name of the street

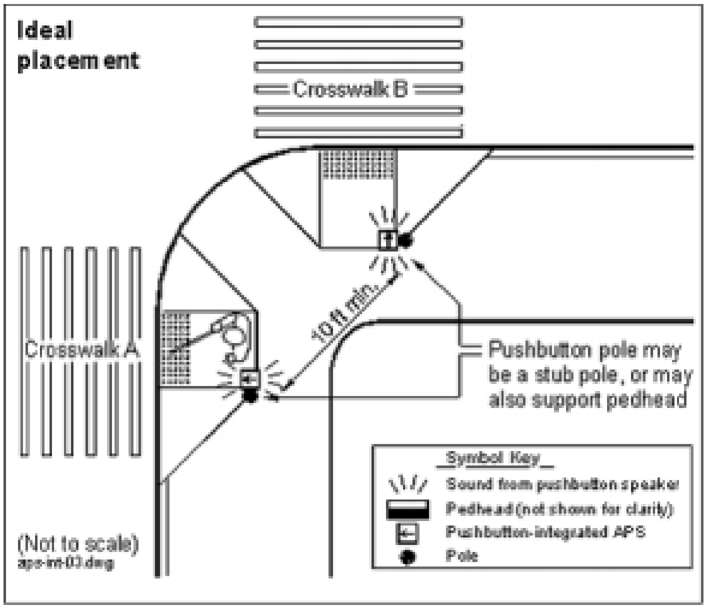
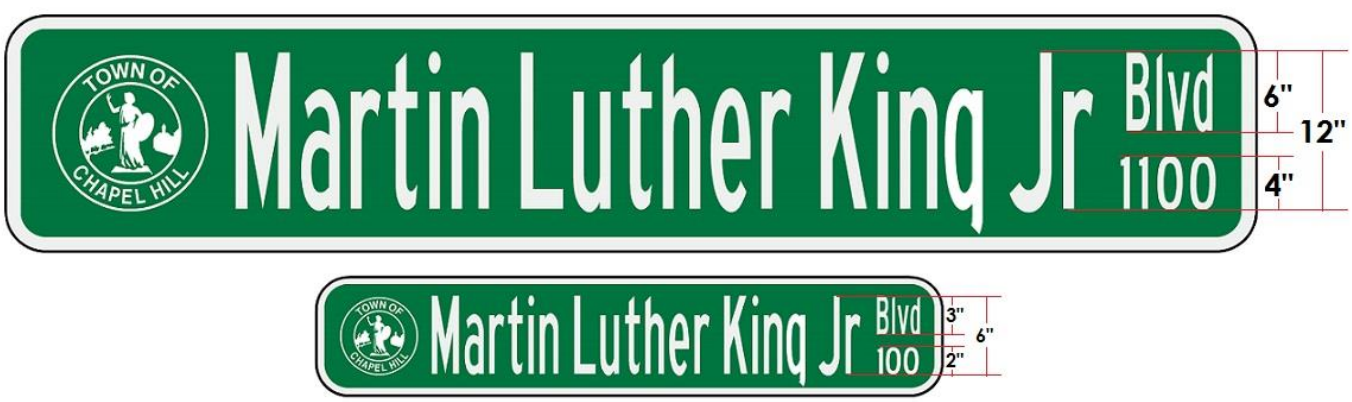


Figure 3.5 - Ideal Installation of a Pushbutton-Integrated APS

Detailed guidelines and resources available in "Accessible Pedestrian Signals: A Guide to Best Practices" at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w117a.pdf.

For better visibility for pedestrians and drivers "non-standard" large street name signs similar to the sign shown below shall be installed on span wires at all current and future signalized intersections.



Detectable Warning Surfaces, United States Access Board Guidelines (2011)

Detectable warning surfaces complying with R305 shall be provided at the following locations on pedestrian access routes and at transit stops:

1. Curb ramps and blended transitions at pedestrian street crossings;
2. Pedestrian refuge islands;
3. Pedestrian at-grade rail crossings not located within a street or highway;
4. Boarding platforms at transit stops for buses and rail vehicles where the edges of the boarding platform are not protected by screens or guards, and
5. Boarding and alighting areas at sidewalk or street-level transit stops for rail vehicles where the side of the boarding and alighting areas facing the rail vehicles is not protected by screens or guards.

Detectable warning surfaces are not required at pedestrian refuge islands which are cut-through at street level and are less than 1.8 meters (6.0 ft) in length in the direction of pedestrian travel. Detectable warning surfaces are not intended to provide wayfinding for pedestrians who are blind or have low vision. Wayfinding can be made easier by:

1. Sidewalks which provide a clear path free of street furniture;
2. Visual contrast between walking and non-walking areas (e.g., planted borders);
3. Route edges which are clear and detectable by cane;
4. Direct pedestrian street crossings and curb ramps which are in-line with direction of travel;
5. Small corner radiuses which permit pedestrian street crossings to be as short and direct as possible; and
6. Orthogonal intersections which facilitate navigation using parallel and perpendicular vehicle sound cues.

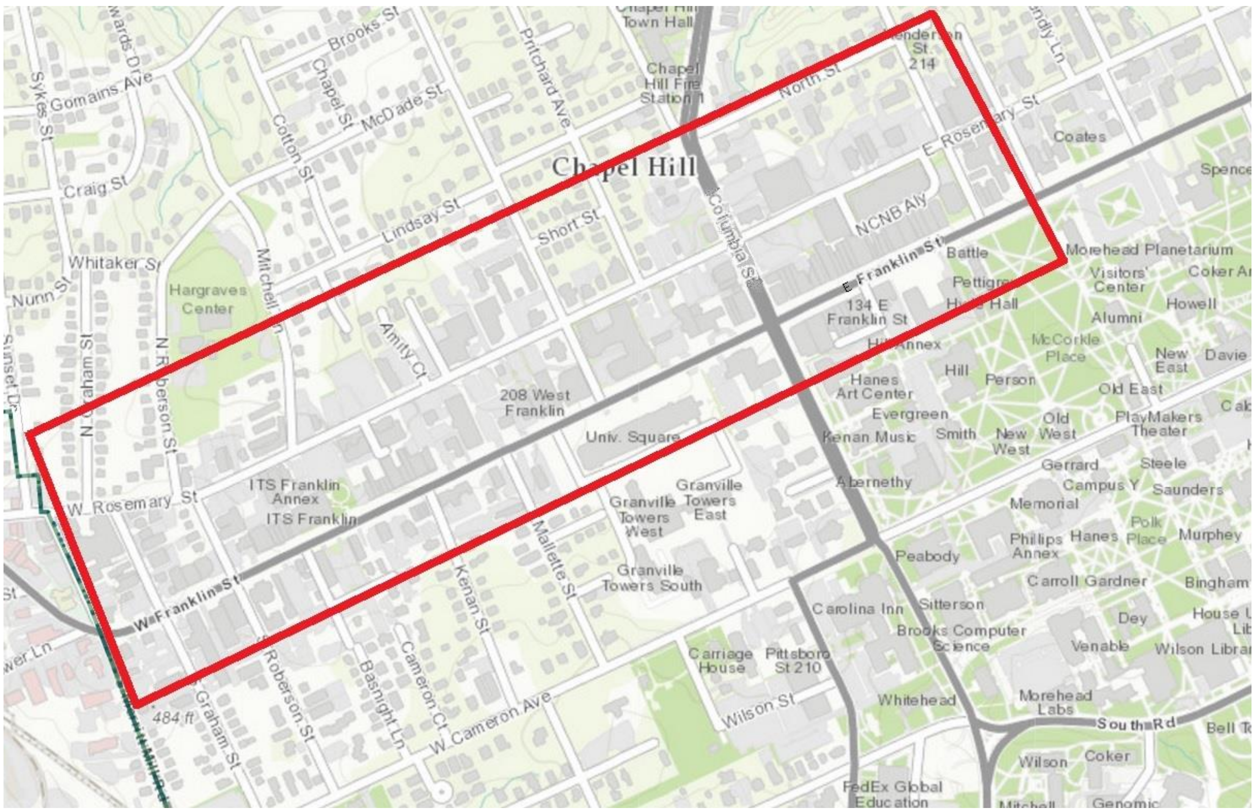
Detectable Warning Surfaces Design Checklist

1. Dome Size – The truncated domes shall have a base diameter of 23 mm (0.9 in) minimum and 36 mm (1.4 in) maximum, a top diameter of 50 percent of the base diameter minimum and 65 percent of the base diameter maximum, and a height of 5 mm (0.2 in).
2. Done Spacing – The truncated domes shall have a center-to-center spacing of 41 mm (1.6 in) minimum and 61 mm (2.4 in) maximum, and a base-to-base spacing of 17 mm (0.65 in) minimum, measured between the most adjacent domes.
3. Contrast – Detectable warning surfaces shall contrast visually with adjacent gutter, street or highway, or pedestrian access route surface, either light-on-dark or dark-on-light.
4. Size – Detectable warning surfaces shall extend 610 mm (2.0 ft) minimum in the direction of pedestrian travel. At curb ramps and blended transitions, detectable warning surfaces shall extend the full width of the ramp run (excluding any flared sides), blended transition, or turning space. At pedestrian at-grade rail crossings not located within a street or highway, detectable warnings shall extend the full width of the crossing. At boarding platforms for buses and rail vehicles, detectable warning surfaces shall extend the full length of the public use areas of the platform. At boarding and alighting areas as sidewalk or street level transit stops for rail vehicles, detectable warning surfaces shall extend the full length of the transit stop.
5. Placement – Design for detectable warnings at various intersection and ramp types are described in greater detail: Access Board's Public Rights-of-Way Accessibility Guidelines.

3.9 STREET LIGHTING

Street Lights and Street Lighting Applicability
A developer may be required to install or upgrade street lights within a public right-of-way as part of the Town's design approval process. The three situations in which these street lighting improvements are typically required include:

1. When new public streets are proposed or existing public streets are improved;
2. When significant development is proposed adjacent to a public street within the Downtown Streetscape Study Area (see map below) where a Street Lighting Master Plan has been adopted calling for the incremental replacement of existing light poles and fixtures. Refer to the Streetscapes section (Chapter 6) for lighting requirements in this area



3. Less commonly, where development is proposed adjacent to inadequately lighted public streets, incremental street lighting improvements may also be required. If there are questions about a specific site, the developer should contact the Town's Public Works Department.

Street Lighting Plan Submittal Requirements
Developers should consult with the appropriate utility provider in the development of proposed street lighting plans. Typically a street lighting plan will include the following information:

1. The proposed location of street lights and the underground utility lines and or conduits which will be installed to service them. If work is proposed within the Downtown

Streetscape Study Area the developer should utilize the standard downtown conduit detail included in the Town's Standard Details.

2. The location of street edge of pavement and/or curb and gutter, sidewalks and all property lines in the area where street lighting is proposed. If other improvements, such as benches or bus stops, are proposed within the public right-of-way, these should also be shown on the plan.
3. A description and/or detail of the proposed light pole and fixture.
4. Most commonly selected street light poles and fixtures require a supplemental fee be paid to the utility provider prior to installation. Where these poles and fixtures are placed within the public right-of-way, utility providers require this supplemental fee be paid through the Town as a one-time up front cost. Accordingly, the following note is required to be included on all street lighting plans:
    a. The developer will be responsible for reimbursing the Town for any and all supplemental fees assessed by the utility provider prior to installation of the proposed light fixtures.
5. For information about the relative supplemental fees assessed for different types of street light poles and fixtures, developers should contact the utility provider.

Street Lighting Guidelines

The type of street light pole and fixture selected and the recommended placement of the poles and fixtures will depend on a number of site-specific variables. In the Downtown Streetscape Study Area several different custom poles and fixtures which provide pedestrian level lighting as well as street lighting are required. See Chapter 6, for fixture and pole requirements.

In other areas within the Town, street lighting design is based on street classification and on the uses of adjacent properties, see Figure 3.16. Because these factors vary from site to site, developers should contact the Public Works Department when proposing street lighting in non-residential areas. In residential neighborhoods the standards for pole and fixture selection and street light placement, as described below, are consistent throughout the Town.

The type of street light pole and fixture selected and the recommended placement of the poles and fixtures will depend on a number of site-specific variables. In the Downtown Streetscape Study Area several different custom poles and fixtures which provide pedestrian level lighting as well as street lighting are recommended. Developers can contact the Public Works Department for information about the specific lighting requirements included in the Street Lighting Master Plan for this area.

Street lighting on State roads must be designed and installed in accordance with the NCDOT standards.

The developer, when installing underground electrical and telephone service shall also install at their expense underground terminal facilities for street lighting along public streets according to the standards required by the Illuminating Engineering Society publication Road Lighting; provided however, the average maintained foot-candle (fc) level for outlying and rural roads as defined in said publication shall be no less than three-tenths (0.3) and the uniformity ratio shall be no greater than sixty-four (64). The Town will not take responsibility for any street lighting system until it meets the above standards.

Developer responsibilities include:

1. Installation of streetlights on all local access system roadways (residential and

commercial), which will be built or improved as part of their development project (.4 fc and 6:1 uniformity).

2. Installation of streetlights on all collector system roadways (residential and commercial), which will be built or improved as part of their development project. (.6 fc and 4:1 uniformity).
3. Installation of streetlights on all minor thoroughfare system roadways, which will be built or improved as part of their development project. (.9 fc and 4:1 uniformity). If the roadway is built to State standards the street lighting is also subject to State lighting requirements.
4. Installation of streetlights on all major system roadways, which will be built or improved as part of their development project (1.2 fc and 4:1 uniformity). If the roadway is built to State standards the street lighting is also subject to State lighting requirements.
5. Installation of streetlights on all secondary system roadways, which will be built or improved as part of their development project. If the roadway is built to State standards, the street lighting is subject to State lighting requirements. The Town may opt to participate in streetlight installations which would close any gaps in the streetlight system created by this requirement.

Table 3.9 – Street Classification Maintained Foot-Candle Street

Street Classifications	Maintained Foot-Candle (average)	Uniformity
Sensitive Area Streets		
1. Sensitive Area Parkway	0.9	6:1
2. Sensitive Area Avenue	0.6	6:1
3. Sensitive Area Residential Street	0.4	6:1
Local Street		
1. Neighborhood Yield	0.4	6:1
2. Neighborhood Local	0.4	6:1
3. Neighborhood Street (Collector)	0.6	4:1
4. Mulitfamily Street	0.6	4:1
Mixed Use Streets		
1. Avenue 2-Lane Undivided	0.9	4:1
2. Avenue 4-Lane Divided	1.2	4:1
3. Avenue 6-Lane Divided	1.2	4:1
4. Multi-Way Boulevard, Parallel Parking	1.2	4:1
5. Multi-Way Boulevard, Angular Parking	1.2	4:1
Industrial and Service Streets		
1. Industrial Street	0.6	4:1
2. Alley, Residential	0.4	6:1
3. Alley, Mixed Use	0.4	6:1
Accessways		
1. Primary Internal Access Drive	0.4	6:1
2. Pedestrian Passage	0.4	6:1

Street Light Pole and Fixture Standards for Residential Streets

The Town's standard residential lighting fixture is a 50, 70, or 110 watt Light Emitting Diode (LED) mounted on a 15' black fiberglass pole. This pole and fixture combination is available from Duke Energy Company and requires that a supplemental fee reimbursement be provided to the Town prior to installation. Comparable pole and fixture combinations are available from other utility providers in areas of Town not served by Duke Energy Company.

Alternatively, LED fixtures mounted on wooden poles at a height of 25' may be acceptable in place of the Town standard fixture. This pole and fixture combination generally does not require a supplemental fee reimbursement. Other fixture and pole combinations, including taller fiberglass poles and/or ornamental fixtures, may be acceptable as long as the developer is responsible for reimbursement of all associated supplemental fees. Developers should contact the Public Works Department if an alternative to the Town standard pole and fixture combination is proposed.

For streets with existing high pressure sodium the Town's standard residential lighting fixture is a 9,500 lumen high pressure sodium "economical traditional" luminaire mounted on a 12' black fiberglass pole. This pole and fixture combination is available from Duke Energy Company and requires a supplemental fee reimbursement be provided to the Town prior to installation. Comparable pole and fixture combinations are available from other utility providers in areas of Town not served by Duke Energy Company.

Alternatively, 9,500 lumen high pressure sodium cut-off lens cobra head fixtures mounted on wooden poles at a height of 25' may be acceptable in place of the Town standard fixture. This pole and fixture combination generally does not require a supplemental fee reimbursement.

Other fixture and pole combinations, including taller fiberglass poles and/or ornamental fixtures, may be acceptable as long as the developer is responsible for reimbursement of all associated supplemental fees. Developers should contact the Public Works Department if an alternative to the Town standard pole and fixture combination is proposed.

Street Light Placement Standards for Residential Streets
The following standards should be used to determine the placement of street lights on residential streets:

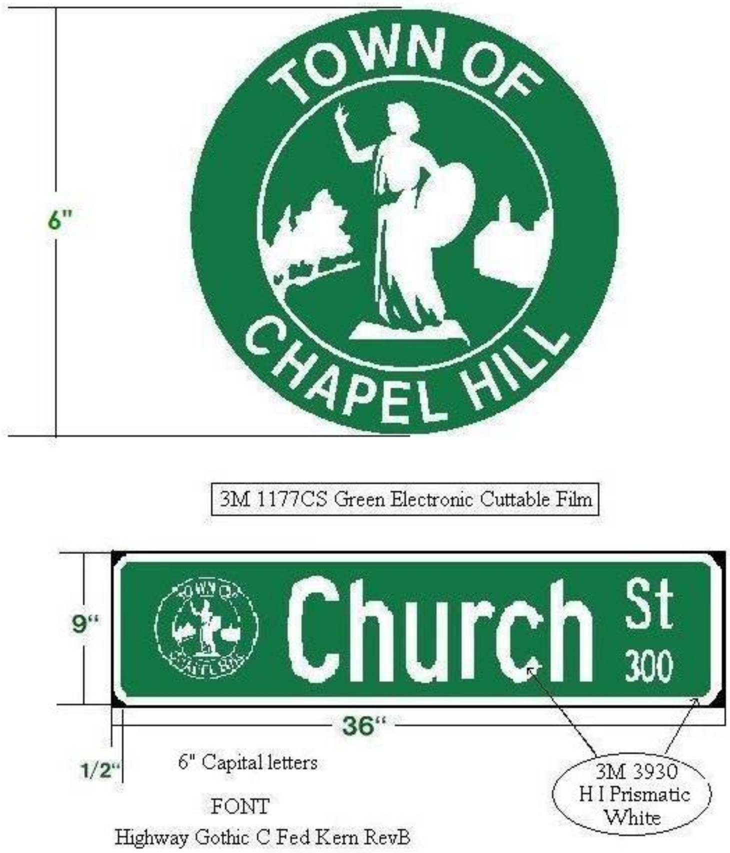
1. Street lights should be located approximately 220 feet apart. The Town staff may approve different pole separation if the foot-candle and uniformity requirements are being met with an alternate design, or if separation from street trees is a consideration.
2. Street lights should be located at all public street intersections and at the end of all cul-de-sacs and T-turnarounds.
3. Where possible, all street lights not located at an intersection should be located on or adjacent to a property corner
4. Street lights should be located within the public right-of-way a minimum of three feet behind the curb or edge of pavement
5. On streets with sidewalks on only one side, street lights should be located on the same side of the street as the sidewalk. On all other streets, street lights should be staggered on both sides of the street.
6. On streets where street lights are proposed adjacent to sidewalks they should be located behind the sidewalk unless a tree lawn is provided which permits all parts of the poles to be located a minimum of three feet behind the curb.

3.10 STREET SIGNS

Street Signs and Markings Applicability
A developer may be required to install or upgrade street signs and markings within a public right-of-way as part of the design review process if the proposed project includes the improvement to or construction of new public streets. The standard Town of Chapel Hill Street Sign Design is detailed in Figure 3.6.

Street Name Signs
Street name signs shall be provided at all street intersections as part of street construction. The location and design of street name signs shall be approved by the Town Manager as in accord with the standards set forth in the Manual on Uniform Traffic Control Devices for Street and Highways.

Figure 3.6 – Standard Town of Chapel Hill Street Sign Design



Street Signs and Markings Plan Submittal Requirements

A street signs and markings plan should show the type and location of all proposed street signs (stop signs, speed limit signs, etc.) and the location of all proposed street markings (centerlines, stop bars, crosswalks etc.). This plan should also include the following Town standard notes, where applicable:

1. Prior to the installation of any street signs or markings, the developer will contact the Town's Public Works Department for an on-site approval of the final design and placement.
2. All pavement markings within the public right-of-way will be installed using a thermoplastic material with a minimum thickness of 125 mils.
3. The developer will be responsible for installation of all required street signs and markings and for any repairs to these signs and markings necessary prior to the final acceptance of a new or improved public street for Town maintenance.

Street Signs and Markings Standards

Where warranted by the need to ensure motorist, bicyclist or pedestrian safety and/or to control vehicular, bicycle and pedestrian traffic; traffic signs and markings should be provided in accordance with the standards set forth in the most current edition of the Manual on Uniform Traffic Control Devices for Streets and Highways. All proposed street signs and markings plans should reflect the standards for sign and marking design and placement as set forth in this manual and should be approved by the Town Manager and, where applicable, NCDOT during the Town's design review process.

Developers can contact the Town's Public Works Department for additional information about the specific design and size requirements for required street signs. Signs which do not meet these design and size requirements will require replacement with approved signs prior to the acceptance of any new or improved public street for Town maintenance.

All pavement markings within the public right-of-way should be installed using a thermoplastic material with a minimum thickness of 125 mils. Pavement markings which do not meet this standard will require replacement with approved markings prior to the acceptance of any new or improved public street for Town maintenance.

3.11 PARKING AND LOADING

Off-Street Parking
The designer must design off-street parking facilities to provide safe, convenient ingress and egress for vehicular traffic and to minimize conflict with pedestrian movements. Access points should be located to provide the optimum driver sight distance and least disruption to traffic on the public street system.

The number of street and driveway connections permitted to serve a single property or commercial development will be the minimum deemed necessary by the North Carolina Department of Transportation for reasonable service to the property without undue impairment of safety, mobility, and utility of the highway. However, only one combined entrance and exit connection will be permitted where the frontage is less than 100 feet. (Policy on Street and Driveway Access to North Carolina Highways July 2003).

When angle parking abuts a sidewalk, it will be necessary for the designer to provide additional clearance between the sidewalk and the parking space to ensure vehicle overhangs would not decrease the useable area of the sidewalk so to not adversely affect the pedestrian and handicap accessible routes.

Geometric Design
The lot layout schedule specifies the minimum standard dimensions for parking spaces and drive aisles, see Table 3.10. All parking spaces should be identified with pavement markings and/or wheel stops. Because of the difficulty of controlling the use of parking spaces, the designer is encouraged to use standard or larger size spaces. If site conditions dictate the necessity of compact spaces, the percentage of compact spaces shall not exceed 20 percent of the total number of spaces.

Typically, no more than ten (10) parking spaces should be arranged side by side without the provision of a landscaped island. The island shall be of sufficient shape and width to provide for landscaping. The minimum width for a landscaped parking lot island is ten (10) feet of pervious soil.

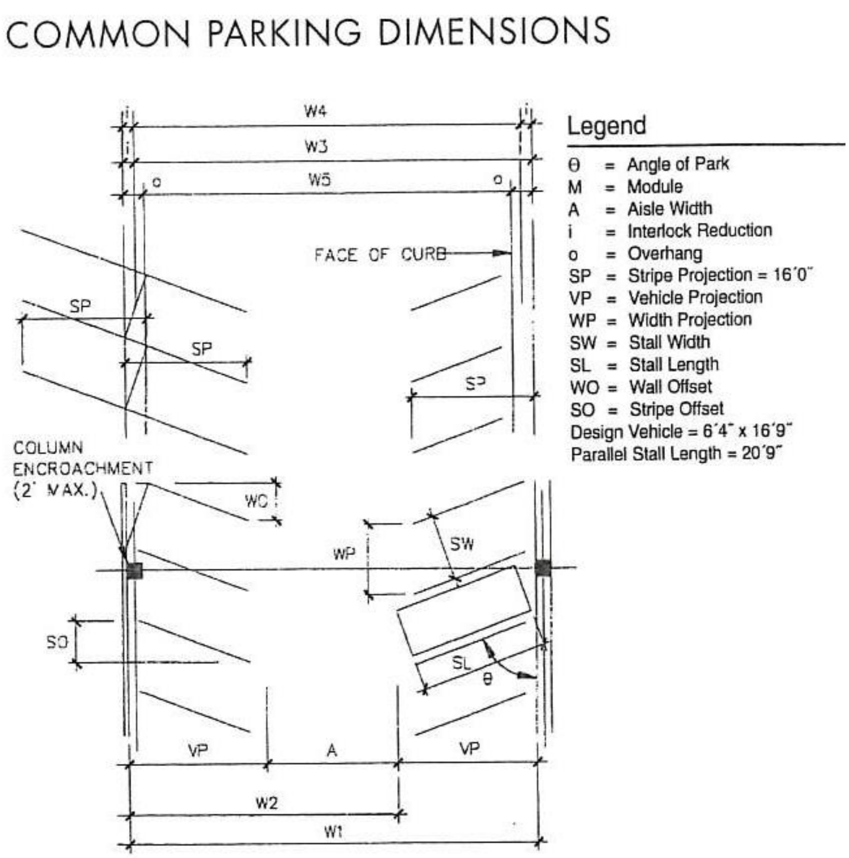
Table 3.10 - Common Parking Dimensions for 8 foot 6 inch Stalls

Angle	Base Module W1	Single Loaded W2	Wall to Interlock W3	Interlock to Interlock W4	Curb to Curb W5	Overhang o	Interlock i	Stall Width Projection WP
45°	48’0”	30’4”	45’0”	42’0”	44’6”	1’9”	3’0”	12’0”
50°	49’9”	31’6”	47’0”	44’3”	45’11”	1’11”	2’9”	11’1”
55°	51’0”	32’4”	48’7”	46’2”	46’10”	2’1”	2’5”	10’5”
60°	52’6”	33’6”	50’4”	48’2”	48’2”	2’2”	2’2”	9’10”
65°	53’9”	34’7”	51’11”	50’1”	49’3”	2’3”	1’10”	9’5”
70°	55’0”	35’9”	53’7”	52’2”	50’4”	2’4”	1’5”	9’1”
75°	56’0”	36’11”	54’11”	53’10”	51’2”	2’5”	1’1”	8’10”
90°	60’0”	42’0”	60’0”	60’0”	55’0”	2’6”	0’0”	8’6”

Dimensions have been rounded to nearest inch.

**Design vehicle = 6’7” x 17’0”.*

Figure 3.7 Common Parking Dimensions



Source: Urban Land Institute and National Parking Association

Minimum Module Dimensions

Parking Angle degrees	Module	Vehicle Projection	Aisle
45	48'0"	17'8"	12'8"
50	49'9"	18'3"	13'3"
55	51'0"	18'8"	13'8"
60	52'6"	19'0"	14'6"
65	53'9"	19'2"	15'5"
70	55'0"	19'3"	16'6"
75	56'0"	19'1"	17'10"
90	60'0"	18'0"	24'0"

Design vehicle = 6'7" x 17'
Stall Width (SW) = 8'5"

Pavement Standards
The minimum standard pavement design for parking lot drive aisles shall be 8 inches of stone base with a 2 inch asphalt surface course. A heavy-duty pavement section will be required in locations determined to be necessary for emergency & service vehicle access lanes designed for a minimum 80,000 pound vehicle. The minimum heavy-duty section shall be 10 inches of stone base and 3 inches of asphalt surface course. An alternative design may be required if geotechnical information or projected traffic patterns dictate a different design. The pavement design for parking space areas must provide an all-weather, dust-free surface. The pavement design shall be based on traffic patterns, frequency of use, soil conditions, and stormwater drainage. Curbing may be required for stormwater control, or as wheel stops to prevent vehicle overhang into landscaped areas or walkways. Wheel stops are required when other means for identifying parking spaces are not practical.

Parking Decks
The use of structured parking facilities is encouraged to minimize the amount of land necessary to accommodate cars. Generally, the geometric requirements for parking decks are the same as for surface parking. However, the designer may provide an alternative design based on accepted practices and subject to the approval of the Town Manager. Refer to the National Fire Protection Association for fire design requirements for parking decks. Modifications may be made to the On-Site Parking Lot Layout graphic (Figure 3.7) when a reduction in aisle width in parking decks and other structures compensates for the increase in the stall width.

Accessible Parking Spaces for the Handicapped
Parking spaces and access aisles for the handicapped shall be on hard or paved surfaces and shall be indicated by pavement markings or other suitable means. The spaces shall be identified with above ground signs as specified in the General Statutes 20-37.6 and 136-30 and the Manual on Uniform Traffic Control Devices.

Standard handicapped accessible parking spaces shall have a 96 inch minimum width and an access aisle adjacent to the space with a minimum width of 60 inches. Van accessible parking spaces shall have a 96 inch minimum width and an access aisle 96 inches wide. The required numbers of spaces are listed in Table 3.11 on the following page.

Figure 3.11 - Accessible Parking Space Requirements

TOTAL NUMBER OF SPACES IN LOT	MINIMUM NUMBER OF ACCESSIBLE SPACES
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1,000	two percent (2%) of total
1,001 and over	20 plus 1 for each 100 or fraction thereof, over 1,000
For every six (6) or fraction of six (6) accessible parking spaces at least one shall be a van accessible parking space.	

Source: 2012 North Carolina Building Code

On-Street Parking
The designer must design on-street parking to provide safe and orderly traffic flow on the street. The primary use of the street is the movement of vehicles. On-street parking is considered a secondary use of street space, as are other uses, such as truck loading zones

Parking prohibitions can be warranted on the basis of statutes, traffic capacity, or accident hazard. Statutory prohibitions also apply to on-street parking spaces near fire hydrants, crosswalks, and approaches to intersections.

Parallel and/or angle parking is allowed on Town streets. However, 90-degree (perpendicular) on-street parking is not permitted. Time restrictions may be posted for on-street parking by means of signs or parking meters to regulate the use of parking spaces. On low-volume, low-speed avenues and streets in commercial main street areas, where sufficient curb-to-curb width is available, angled parking may be appropriate. Angle parking should have the dimensions shown in Figure 3.12 for a variety of different angles.

Dimensioning of on-street parking spaces shall take into account driver sight distance, pedestrian patterns and maneuvering area for vehicles. For more information please contact the Town of Chapel Hill Public Works/Engineering Department.

Table 3.12 - Minimum Dimensions for Head-In Angled On-Street Parking*

Angle	Stall Width	Stall Depth (perpendicular to curb)	Minimum Width of Adjacent Lane	Curb Overhang
45°	8.5-9.0 feet	17 feet 8 inches	11 feet 4 inches	1 foot 9 inches
50°	8.5-9.0 feet	18 feet 3 inches	13 feet 3 inches	1 foot 11 inches
55°	8.5-9.0 feet	18 feet 8 inches	13 feet 8 inches	2 feet 1 inches
60°	8.5-9.0 feet	19 feet 0 inches	14 feet 6 inches	2 feet 2 inches

Source: Dimensions of Parking, 4th Edition, Urban Land Institute Notes:
** Typical design vehicle dimensions: 6 feet 7 inches by 17 feet 0 inches. Use 9.0 feet wide stall in commercial areas with moderate to high parking turnover.*
Note: Sharper angles may be approved by the Town

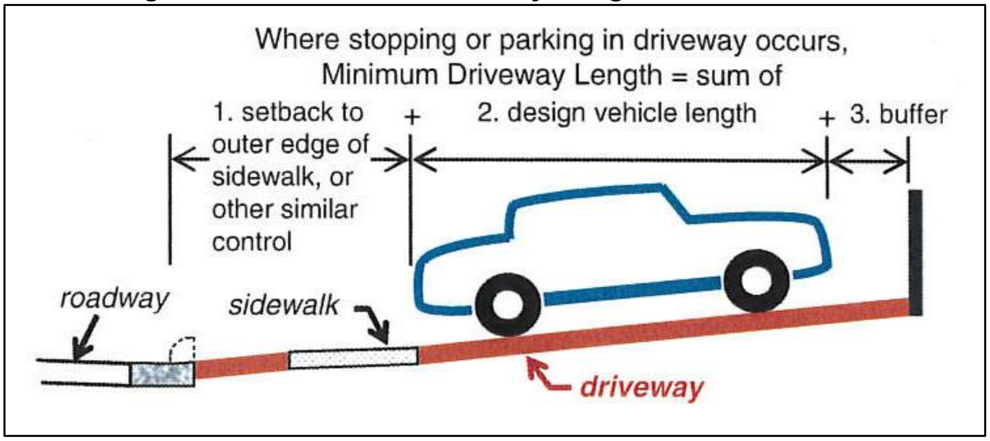
Loading Space Requirements
Off-street loading spaces shall be designed so a semi-trailer truck (WB 40 design) can use the space by means of one continuous parking maneuver. The off-street loading space shall have a minimum width of 12 feet, a minimum length of 55 feet, and a vertical clearance of 14 feet above the finished grade. A smaller loading space may be used on a case-by-case basis where smaller trucks will be used, or delivery hours will be managed.

3.12 GEOMETRIC DESIGN OF DRIVEWAYS

Minimum Driveway Length Considerations
- Determine the longest vehicle type likely to use the driveway.
- Determine the length of subject vehicle.

- Estimate a front buffer dimension. In the case of a smaller design vehicle (e.g., a P-car), estimate 2 feet. For a larger design vehicle (e.g., a bus or large truck), select 3 feet. If the front buffer area involves a gate which swings outward, there also should be an allowance for the gate.
- Estimate a value for the rear clearance. Where a sidewalk exists, this is the distance from the edge of the traveled way to the far edge of the sidewalk. If no sidewalk exists, allow a mini- mum of 2 feet.
- Sum these values to determine the minimum driveway length.

Figure 3.8 - Minimum Driveway Length Considerations



Source: National Cooperative Highway Research Program (NCHRP) -Report 659

Minimum Length of Driveway Paving

If the driveway within the private property site is dirt or gravel, how far back from the edge of the traveled way to pave the driveway connection is an issue. The minimum length of driveway paving is 10 feet or to the right-of-way line, whichever is less. However, a greater length may be required.

The objectives of paving the connection to a gravel or dirt driveway some distance back from the traveled way edge include (1) providing a more stable driveway surface "platform" from which to enter or exit the traveled way and (2) minimizing or eliminating the depositing of dirt, gravel, or mud onto the traveled way. Factors which can affect the extent to which debris from such a private driveway are deposited on the traveled way include:

- The distance from the traveled way edge to the beginning of the gravel or dirt surface;
- The grade of the driveway;
- Surface drainage patterns, combined with the amount of precipitation; and
- The volumes and types of traffic using the driveway.

Driveway Grades Adjacent to Right-of-Way

Maximum allowable grade, by itself, is not a sufficient control. What matters is the difference between successive grades, or the change of grade. The change of grade may create the crests and sags which cause the underside of a vehicle to drag.

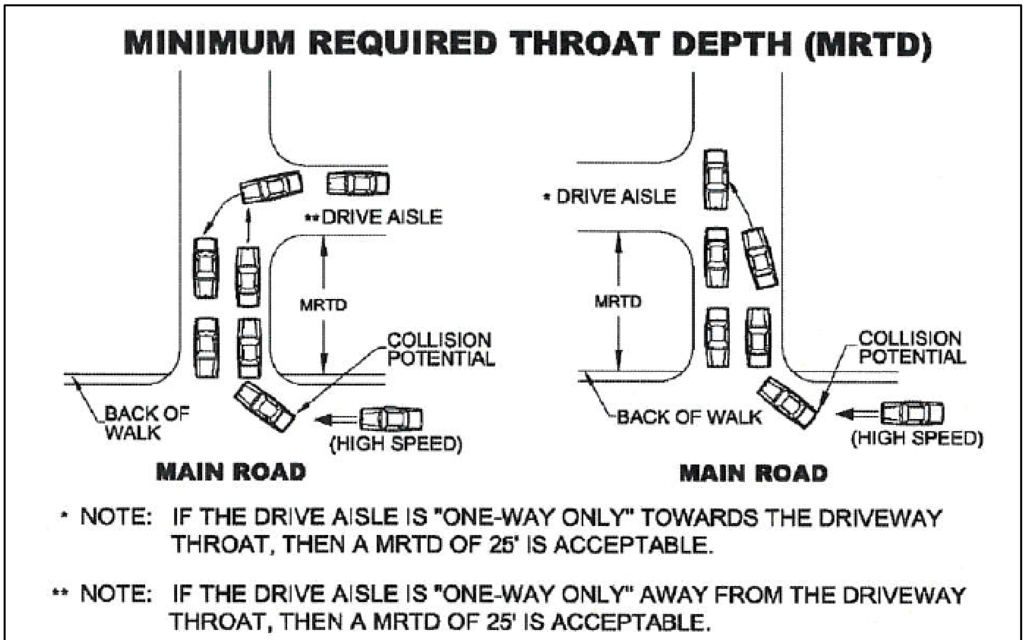
Table 3.13 - Steepest Allowed Driveway Grades Adjacent to Right-of-Way

	Commercial	Residential
Grade: maximum from road allowed	10%	15%

Driveway Minimum Required Throat Depth (MRTD)

The distance between internal drive aisles and the street can affect traffic operation and safety. In order to protect the storage and operational needs of the driveway/street intersection, a protected driveway stem of a sufficient link may be required. The designer should provide 50 foot minimum vehicle storage length (minimum required throat depth) for driveway intersections with the street. Alternate distances may be used if dictated by sight conditions.

Figure 3.9 – Minimum Required Throat Depth (MRTD)



Source: City of Roseville, CA, Design Stds., Section 4, p. 9, March 2007

Driveway Grade (Sidewalk Cross Slope), Change of Grade, and Vertical Alignment
Three types of control for the design of the driveway profile are physical, operational, and drainage:

- Physical controls call for a design which maintains enough clearance so the underside of a vehicle does not drag on the roadway or driveway surface. This control is necessary for all driveways, even ones connecting to an alley. Due to the changes in vertical profile grade often found at driveway entrances, these locations are more vulnerable to hang ups when the undercarriage of the vehicle comes into contact with or "drags" the pavement surface.

- Operational controls dictate vertical alignment for the driveway allowing a convenient and safe entry with minimal conflicts. To achieve this, the changes of gradient must not be too abrupt. This is especially important on driveways which intersect higher volume or higher speed roadways. Operational problems may arise from certain combinations of vertical profiles and vehicles. One problem is vehicle occupant discomfort due to poor vertical alignment such as bumps, steep grades, and abrupt changes in grade. In extreme cases, there may be restricted sight distance which adversely affects safety. In addition, excessive differences in speed between through vehicles and vehicles turning into or out of the driveway from a vertical profile can also increase vehicles' exposure to crashes.

- Drainage requires a profile which does not create undesirable flow patterns. It may be unacceptable for street runoff to flow into the driveway opening and onto private property, and for stormwater run-off to flow from a driveway into the street.

Physical Vehicle Ground Clearance Control
As Figure 3.10 shows, the underside of a vehicle entering or exiting a driveway can drag on either a crest or a sag alignment with an abrupt change of grade. Any excessive grade change between the cross slope of the roadway and the driveway grade, between the driveway grade and an intersecting sidewalk, or between successive driveway grades can cause a vehicle to drag. Vehicles with low ground clearance and a long wheelbase or overhang can even become lodged (also referred to as "hung up" or "high-centered") on alignments with sharp grade changes. At best, hang-ups result in some vehicular delay and minor damage to the undercarriage of the vehicle and to the pavement surface. At worst, a crash can occur.

Figure 3.10 (Source: NCHRP)

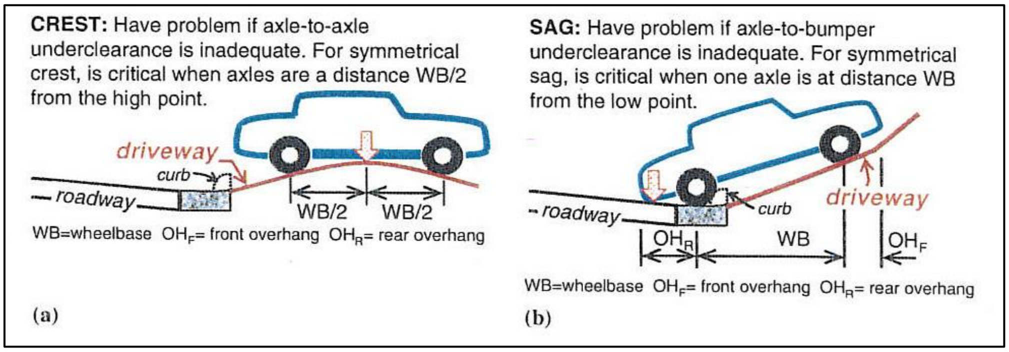


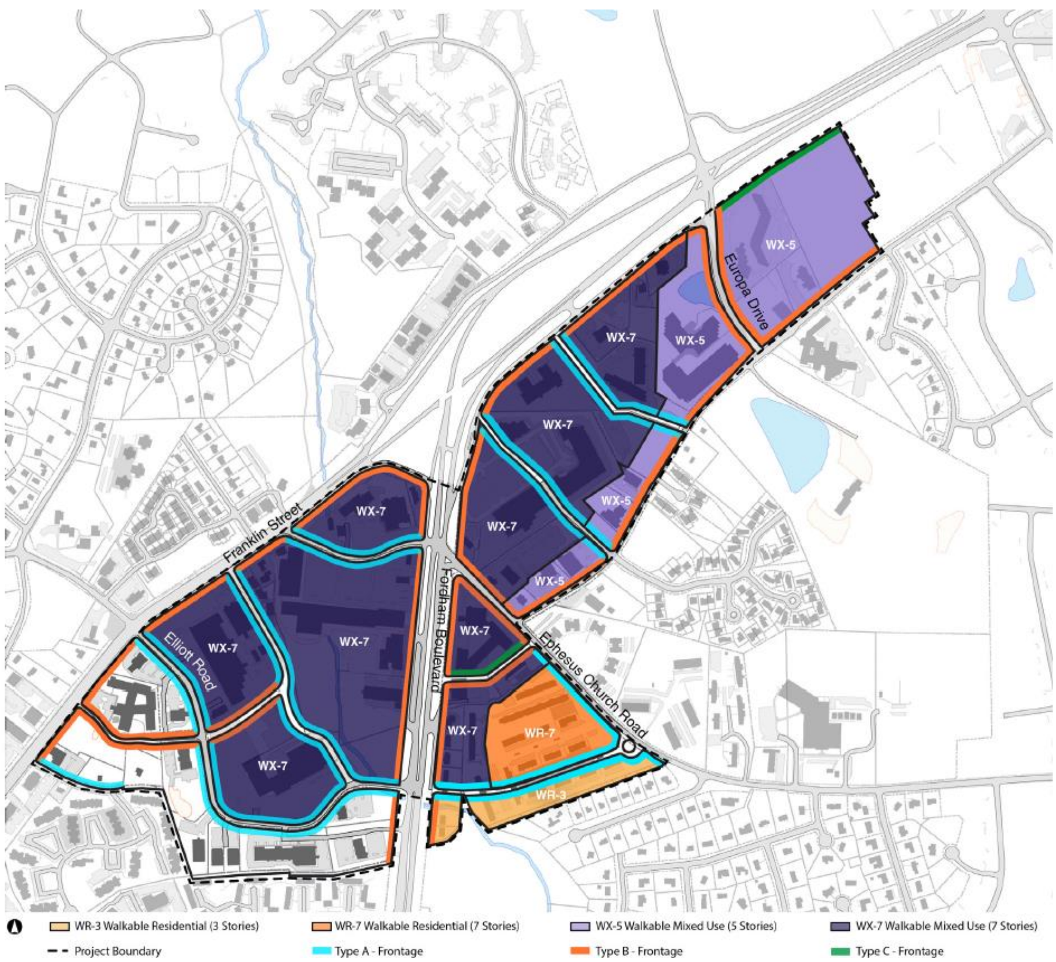
Table 3.14 - Minimum Length of Crest Vertical Curve to Accommodate Low-Clearance Vehicle at Driveway Intersection with Street

Algebraic Difference (%)	Curve Length	
	Feet	Meters
1	4	1.2
2	8	2.4
3	12	3.7
4	16	4.9
5	20	6.1
6	24	7.3
7	28	8.5
8	32	9.8
9	35	10.7
10	39	11.9

3.13 THE BLUE HILL DISTRICT (FORMALLY KNOWN AS EPHESUS-FORDHAM)

The Blue Hill District is identified in Chapel Hill's Comprehensive Plan as an area of focus for economic growth and development and improved transportation conditions. It is located north and east of the University and along the main corridor connecting the Town to Durham. This area is currently characterized by older, suburban shopping strips and traffic patterns that are not conducive to safe pedestrian and bike travel. Given its prominent location, the Blue Hill District has the potential to become a lively, mixed-use district accessible to those who live both within it and nearby. In response to the small area plan, the Town created the Ephesus Fordham Form Based Code as a means of implementing the vision and community goals: "To create a pleasant walking experience, and a mix of commercial uses, upper story residences and offices, bike paths, and sidewalk cafes." It is a prescriptive document guiding the built environment of the district including street typology. To compliment the building elements of the Form Based Code, this section of the manual was created to further define the character of the streets. Additional design criteria will be developed with input from stakeholders and the community.

Figure 3.11 – Blue Hill District



Type A With On-Street Parking

Type A Without On-Street Parking

TYPE A FRONTAGE		
Building Location		
Ⓐ	Front setback (min/max)	0' / 10'
	Building façade in BTZ (min % of lot width)	80%
Streetscape		
Ⓑ	Sidewalk (min)	10' with 10' minimum clear zone
Ⓒ	Tree planting zone (min)	8'
	Tree spacing (on center, avg)	40'
Ⓓ	On-street parking, where provided (min)	8'
Parking Location		
Surface parking: Not permitted between building and street		
Structured parking: 30' minimum behind front building façade for all floors		

Canopy trees are required unless utility conflicts exist, in which case an equivalent or better alternative can be reviewed and approved by the Community Design Commission.

Type B Frontage

TYPE B FRONTAGE		
Building Location		
Ⓐ	Front setback (min/max)	0' / 85'
	Building façade in BTZ (min % of lot width)	60%
Pedestrian Way		
Ⓑ	Sidewalk (min)	8'
Ⓒ	Tree planting zone (min)	8'
	Tree spacing (on center, avg)	40'
Vehicular Way		
Ⓓ	Parking area (max)	60'
Ⓔ	Hedge planting or wall zone (36" min height)	5' (min width)
Streetscape		
Ⓕ	Sidewalk or multiuse path not in conjunction with a Town plan (min) OR	6' with 6' minimum clear zone OR
	Sidewalk or multiuse path built in conjunction with a Town plan (min)	10' with 10' minimum clear zone
Ⓖ	Tree planting zone (min)	8'
	Tree spacing (on center, avg)	40'
Parking Location		
Surface parking: 2 bays maximum permitted between building and street		
Structured parking: 30' minimum behind front building façade for all floors		

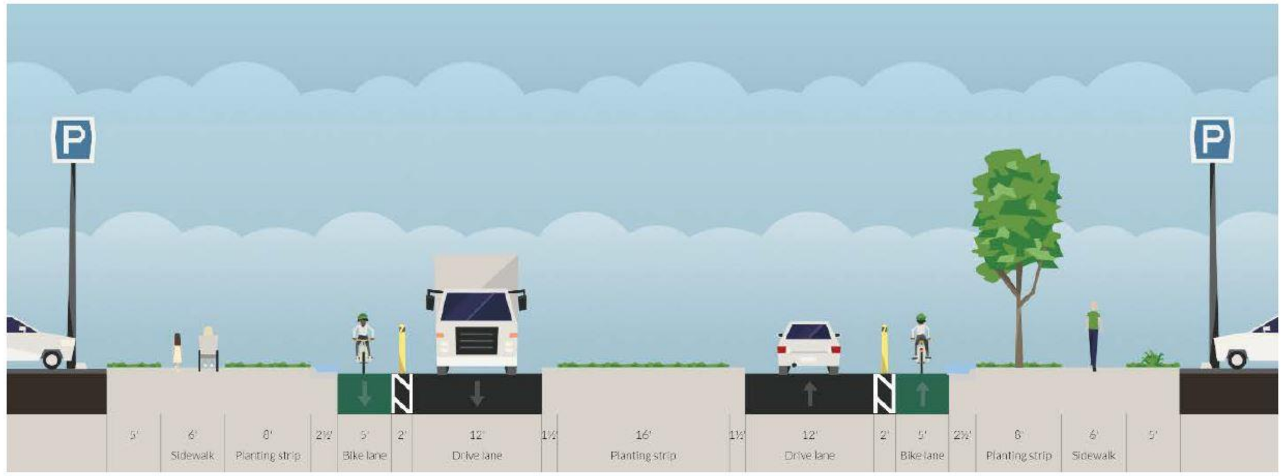
Canopy trees are required unless utility conflicts exist, in which case an equivalent or better alternative can be reviewed and approved by the Community Design Commission.

Type C Frontage

TYPE C FRONTAGE		
Building Location		
Ⓐ	Front setback (min/max)	5'
	Building façade in BTZ (min % of lot width)	n/a
Vehicular Way		
Ⓑ	Parking area (min)	Unlimited
Ⓒ	Hedge planting or wall zone (36" min height)	5' (min width)
Streetscape		
Ⓓ	Sidewalk or multiuse path not in conjunction with a Town plan (min) OR Sidewalk or multiuse path built in conjunction with a Town plan (min)	6' with 6' minimum clear zone OR 10' with 10' minimum clear zone
Ⓔ	Tree planting zone (min)	8'
	Tree spacing (on center, avg)	40'
Parking Location		
Surface parking: No restriction		
Structured parking: No restriction		

Canopy trees are required unless utility conflicts exist, in which case an equivalent or better alternative can be reviewed and approved by the Community Design Commission.

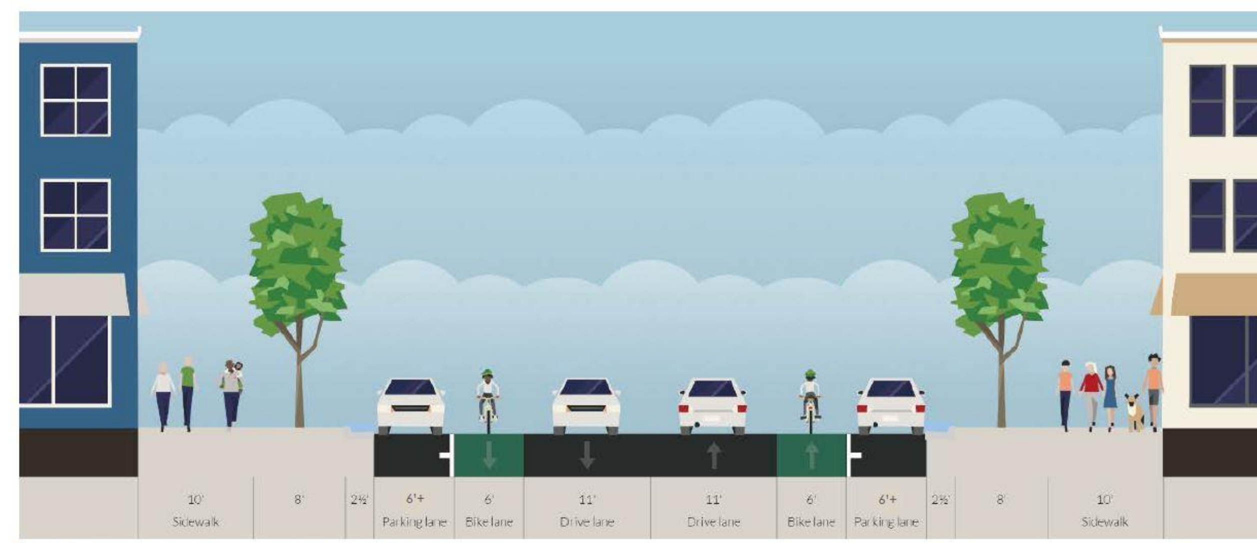
Figure 3.12 – Blue Hill Street Sections



Arterial with Buffered Bike Lanes			
Right-of-way	Arterial – 117' min, 124' typical Minor Arterial – 93' min, 100' typical	Frontages	Type B (typical)
Median	Landscaped: 9' minimum, 16' preferred + 1.5' mountable curb & gutter Center Turn Lane: 12' minimum	Travel Lanes	Arterial – four 12' lanes Minor Arterial – two 12' lanes
Bike Facilities	Buffered* bike lanes (5' lane + 2.5' curb & gutter, 2'min buffer*) ** Buffer required when speed limit ≥ 35mph*	Planting Zone	8' planting strip 5' hedge planting strips behind sidewalk
Sidewalks	6' minimum	Parking	No on-street parking

Collector with Bike Lanes – Residential Context			
Right-of-way	73' min	Frontages	Type A (typical)
Median	None	Travel Lanes	Two 11' lanes
Bike Facilities	5' bike lanes min. + 2.5' curb & gutter	Planting Zone	8' tree grates in sidewalk
Sidewalks	10' minimum	Parking	None

Local Street with Sharrows			
Right-of-way	75' min	Frontages	Type A or B (according to code)
Median	None	Travel Lanes	Two 11-12' lanes
Bike Facilities	Shared lane markings (i.e. sharrows)	Planting Zone	Type A - 8' tree grates in sidewalk Type B - 8' planting strip 5' hedge planting strips behind sidewalk
Sidewalks	Type A - 10' minimum Type B - 6' minimum	Parking	8' min (including gutter) 2.5' curb & gutter



Collector with Bike Lanes – Commercial Context			
Right-of-way	85' min	Frontages	Type A (typical)
Median	None	Travel Lanes	Two 11' lanes
Bike Facilities	6' bike lanes adjacent to parking	Planting Zone	8' tree grates in sidewalk
Sidewalks	10' minimum	Parking	2.5' curb & gutter Parallel - 8' min (including gutter) Perpendicular – 18' minimum 60° diagonal – 16' typical

Elements Overview

BUILDING BLOCKS OF GREAT STREETS

There are many different elements working together to create successful streets. They are used in purposeful ways to create experiences for those who use them. For example, variety and transparency provide interest to pedestrians as they walk down the street. Trees provide shade and benches a place to rest or stop and visit. Detail in paving patterns and the intricate design of tree grates let people know they are somewhere special. These are all tools in the kit of parts that makeup a successful street; one that defines the character of place.

The remainder of this document will utilize the elements below in a way that allows the streets to effectively communicate the values of the district.

	FRONTAGE A	FRONTAGE B	FRONTAGE C	ALT. ACCEPTED*
PAVING				
Sidewalk	•	•	•	
Minor Crossings	•	•	•	A
Major Crossings	•	•	•	A
Bike Lanes	•			
Tree Grates	•	•		
Drainage Grates	•	•		
On-Street Parking	•	•		
LIGHTING				
Street Lighting	•	•	•	
Uplighting	•			A
Traffic Signals	•	•	•	
Pedestrian Signals	•	•	•	
SOUND				
Crosswalk	•	•	•	
Sidewalk Speakers	•			A
FURNISHINGS				
Bus Shelter	•	•	•	
Bike Rack	•	•		A
Waste Collection	•	•	•	A
GREEN INFRASTRUCTURE				
Infiltration Gardens	•	•		A
Site Appropriate Plantings	•	•	•	A

* A = ALTERNATIVE ACCEPTED WITH PLANNING DEPARTMENT APPROVAL

PAVING
SIDEWALK

FRONTAGE **A**

PRODUCT INFO

MANUFACTURER:
Endicott Clay Products Co.
PRODUCT NAME:
4"x8" Pedestrian/Light Vehicular Pavers (ASTM C902)
PRODUCT #/CODE:
COLOR:
15% Medium Ironspot #46
70% Dark Ironspot
15% Manganese Ironspot
FINISH/TEXTURE:
Wirecut
PATTERN:
45 Degree Herringbone Field
Soldier Course Manganese Ironspot Edges

PLACEMENT:

Sidewalk:
Public sidewalks between roadways and building facades

NOTES:

Depth of Pavers as per manufacturers recommendation based on loading requirements.

Herringbone field to have sand swept joints in sand setting bed.

Soldier course rowlock edging to have sand swept joints in mortar setting bed.

Install pavers in accordance with manufacturer's instructions and in proper relationship with adjacent construction.

PAVING
CROSSWALKS

FRONTAGE A

PRODUCT INFO

MANUFACTURER:
Ennis Flint
PRODUCT NAME:
DuraTherm Thermoplastic TrafficScape
PRODUCT #/CODE:
32W-08 (8')
COLOR:
White
PATTERN:
Wheels
8"-12" continuous edge border
Typical width of 8'

PLACEMENT:

CROSSWALK:
Frontage intersection A/A
Frontage intersection A/B internal to the district

NOTES:

Custom Crosswalk Designs may be implemented at culturally significant intersections as approved by Chapel Hill Planning Staff

Crosswalk widths and placement in relation to intersection must meet all Town of Chapel Hill standards

Example of Acceptable Alternative:
CUSTOM CROSSWALK DESIGN
Nascar Hall of Fame Checkered Flag Crossing

PAVING
MINOR CROSSINGS

FRONTAGE **A**

PRODUCT INFO

MANUFACTURER:
Endicott Clay Products Co.
PRODUCT NAME:
4"x8" Heavy Vehicular Pavers (ASTM C1272)
PRODUCT #/CODE:
COLOR:
Dark Ironspot
FINISH/TEXTURE:
Wirecut
PATTERN:
Running bond brick paver field
Min 8" Concrete edging bands contain brick field

PLACEMENT:

DRIVE CROSSINGS
Where private drives or alleys cross the sidewalk in the public right of way

NOTES:

Depth of Pavers as per manufacturers recommendation based on loading requirements.

Install pavers in accordance with manufacturer's instructions and in proper relationship with adjacent construction.

Heavy vehicular rating required for concrete bands

PAVING
BIKE LANES

FRONTAGE **A**

PRODUCT INFO

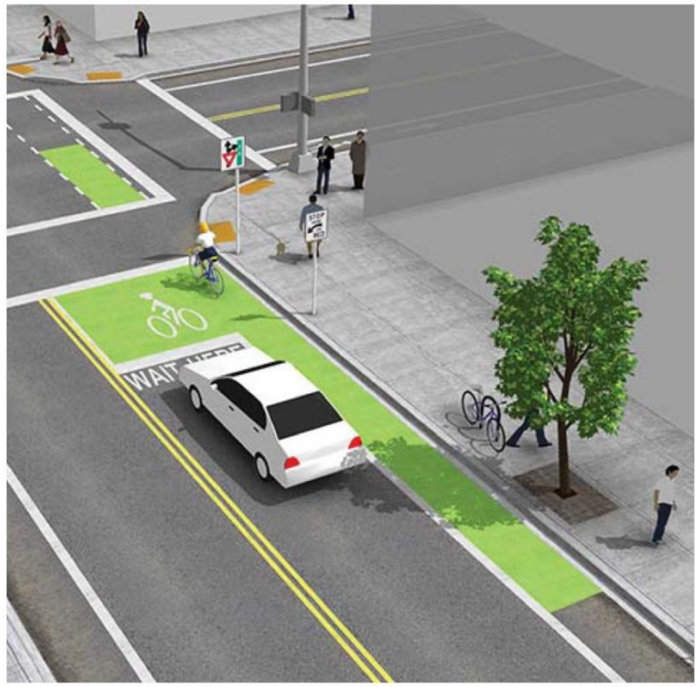
MANUFACTURER:
Ennis Flint
PRODUCT NAME:
PreMark
PRODUCT #/CODE:
N/A
COLOR:
Green
FINISH/TEXTURE:
Wirecut
PATTERN:
Green PreMark shall be used for bike boxes at intersections; bike lane shall be asphalt with white bicyclist symbols at 250'-500' intervals

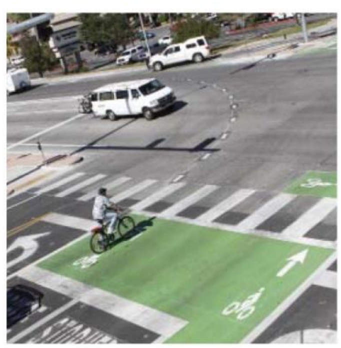
PLACEMENT:

BIKE LANES
Where bike lanes are required as per the Chapel Hill Bike Plan

NOTES:

Application of markings to meet manufacturer's specifications





PAVING
TREE GRATES

FRONTAGE **A**

PRODUCT INFO

MANUFACTURER:
Iron Age Designs
PRODUCT NAME:
6' Square Oblio Tree Grate
PRODUCT #/CODE:
OX72-72I99TG
COLOR:
N/A
FINISH/TEXTURE:
Raw Cast Iron
PATTERN:
Oblio

PLACEMENT:

Tree Planting Zone
Around street trees not located in planters or infiltration gardens

NOTES:

18" concrete band to surround tree grate

Sistemalux Basik LED Walkover Light Fixture to be installed within all tree grate as per manufacturer's specifications.

All tree grates to be ADA compliant

PAVING
DRAINAGE GRATES

FRONTAGE A

PRODUCT INFO

MANUFACTURER:
Iron Age Designs
PRODUCT NAME:
5" Oblio Heel Proof Trench Drain
PRODUCT #/CODE:
OM5-20I21HP
COLOR:
N/A
FINISH/TEXTURE:
Raw Cast Iron
PATTERN:
Oblio

PLACEMENT:

Drainage Areas:
Trench Drains to be placed as needed for drainage.
Suggested locations include on-street between asphalt drive aisle and bike lanes and connecting curbs and infiltration gardens.

NOTES:

All trench drains to be installed as per manufacturer's specifications.

All trench drains to be ADA compliant.

Not for installation in the public right-of-way unless approved by the Town.

LIGHTING
STREET LIGHTING

FRONTAGE A

PRODUCT INFO

MANUFACTURER:
Sternberg Lighting
PRODUCT NAME:
Solana Post Top - Large with Intellistreets
14' Round Straight Steel Pole
PRODUCT #/CODE:
SL760
RSS14F400
COLOR:
Black
FINISH/TEXTURE:
Urban Black Matte Powder Coat
PATTERN:
Maximum 60' spacing in opposite arrangement along street length

PLACEMENT:

Planting Zone:
Lights to be installed in line with trunks of street trees along length of street (typ. 2'-6" from back of curb)

NOTES:

Intellistreets models to be used to increase energy efficiency and allow for built in speakers for announcements and music

Intellistreets digital banner to be installed every corner and mid-block.

Energy Efficient LEDs

LIGHTING
UPLIGHTING

FRONTAGE A

PRODUCT INFO

MANUFACTURER:
Bega
PRODUCT NAME:
In-ground Luminaire
PRODUCT #/CODE:
77 055
COLOR:
3000 K colour temperature
FINISH/TEXTURE:
Stainless Steel
PATTERN:
5.7" round

PLACEMENT:

Planting beds:
Position to uplight trees (not in tree grates) and buildings as needed to provide adequately lit spaces

NOTES:

Lights to be installed as per manufacturer's specification

(Developer option)

LIGHTING
TRAFFIC SIGNALS

FRONTAGE A

PRODUCT INFO

MANUFACTURER:
Millerbernd (or approved equivalent)
PRODUCT NAME:
Single Arm mast arm traffic signal
PRODUCT #/CODE:
N/A
COLOR:
Black
FINISH/TEXTURE:
Black wet paint
PATTERN:
Smooth cylindrical shape; no square or octagonal shapes permitted.
Arm extension should have an arching shape

PLACEMENT:

Intersections:
Where street lights are required according to city and state regulations
Loction of mast arm poles will be determined by pedestrian and vehicular circulation patterns at each itnersection

NOTES:

Mast arm poles to be custom designed at each intersection based on conditional requirements.

Pedestrian signals will be placed at base of mast arms

LIGHTING
PEDESTRIAN SIGNALS

FRONTAGE A

PRODUCT INFO

MANUFACTURER:
GE (or approved equivalent)
PRODUCT NAME:
GE LED Countdown Pedestrian Signal
PRODUCT #/CODE:
PS7-CFF1-27A-023
COLOR:
Black
FINISH/TEXTURE:
Polycarbonate
PATTERN:

PLACEMENT:

Intersections:
Where street lights are required according to city and state regulations

NOTES:

Pedestrian signals shall meet all requirements of applicable codes.

SOUND
PEDESTRIAN SIGNALS

FRONTAGE A

PRODUCT INFO

MANUFACTURER:
Pelco (or approved equivalent)
PRODUCT NAME:
Intellicross Accessible Pedestrian Signal
PRODUCT #/CODE:
SE-2900-PXX5" X 7 3/4" STANDARD
COLOR:
Flat Black
FINISH/TEXTURE:
Polycarbonate
PATTERN:
N/A

PLACEMENT:

Intersections:
All signalized pedestrian crossings should

NOTES:

Pedestrian signals shall meet all requirements of applicable codes.

Vibrating button when signal has been sent

Auditory street information communicated when walk sign engaged

Auditory signals become more prominent when ambient sound is present

Cuckoo sound used for North South crossings

Chirp chirp sound used for East West crossings

FURNISHINGS
BUS SHELTER

FRONTAGE A

PRODUCT INFO

MANUFACTURER:
Landscape Forms (or approved equivalent)
PRODUCT NAME:
4'x12' Connect Shelter
PRODUCT #/CODE:
N/A
COLOR:
Silver
FINISH/TEXTURE:
Silver Metallic Powdercoat
PATTERN:
N/A

PLACEMENT:

Transit Stops:
As required as per transit authority plans

NOTES:

Solar LED lighting with LED driver and 6 VDC batteries for dusk to dawn operation. 12ft shelter: (20) 6v batteries wired in series and parallel to form a 12v 72Ah battery.

All Rear Glass

Install as per manufacturer's specifications

FURNISHINGS
BIKE RACK

FRONTAGE A

PRODUCT INFO

MANUFACTURER:
Froms + Surfaces
PRODUCT NAME:
Twist Bike Rack
PRODUCT #/CODE:
N/A
COLOR:
Silver & Blue
FINISH/TEXTURE:
Silver Texture Powdercoat
Azure Texture Powdercoat
PATTERN:
Silver texture powdercoat bike racks shall be used along streetscape
Azure texture powdercoat must be used at intersections, plazas, parks, and major

PLACEMENT:

Planting zone and/or adjacent to building:
Groupings of 3 bike racks shall be spaced no more than 200' apart along the length of the street

NOTES:

Surface mount with embedded tamper-resistant anchors.

Alternative installations may be considered by the Town.

FURNISHINGS
WASTE COLLECTION

FRONTAGE A & B

PRODUCT INFO

MANUFACTURER:
SiteScapes (or approved equivalent)
PRODUCT NAME:
Cambridge Trash Receptacle
PRODUCT #/CODE:
CM2-1002-SF (Trash)
CM2-1001-SF (Recycling)
COLOR:
Silver
FINISH/TEXTURE:
Stainless Steel
PATTERN:
Recycling containers shall have blue recycling symbol

PLACEMENT:

Along street frontage where big belly waste receptacles are not required:
The Cambridge trash and recycling receptacles must be located within 5' of all benches and shall be spaced so there is no more than 200' between any 2 waste receptacles.

NOTES:

All trash receptacles must be placed with a recycling receptacle either directly adjacent to the trash receptacle or seperated by no more than 10'.

Dome top should be used for recycling. Ash tops may be used for trash receptacles.

LANDSCAPE
PLANT LIST

FRONTAGE **A**

TREES

S = Street

Scientific Name	Common Name	S	Caliper (min)	Ht (min)	Light
Magnolia x soulangeana	Saucer Magnolia	•	2"	6'	sun / part shade
Quercus bicolor	Swamp White Oak	•	3"	12'	sun / part shade
Quercus falcata var. Pagodifolia	Cherrybark Oak	•	3"	12'	sun / part shade
Quercus shumardii 'Panache'	Panache Shumard Oak	•	3"	12'	sun / part shade

SHRUBS

I = Island (street parking)
H = Hedge
R = Raised Planter

Scientific Name	Common Name	I	H	R	Ht (min)	Light
Euonymus kiautschovicus 'Manhattan'	Manhattan Euonymus		•		24"	sun / part shade
Itea virginica 'Merlot'	Merlot Sweetspire	•			24"	sun / part shade
Loropetalum chinensis 'Shang-White'	Emerald Snow Fringeflower		•		24"	sun / part shade
Myrica cerifera 'Don's Dwarf'	Don's Dwarf Waxmyrtle	•	•		24"	sun / part shade
Thuja occidentalis 'Hetz Midget'	Hetz Midget Arborvitae	•	•		24"	sun / part shade

GRASSES / PERENNIALS

I = Island (street parking)
R = Raised Planter
B - Bio-infiltration Garden

Scientific Name	Common Name	I	R	B	Size (min)	Light
Acorus calamus	Sweet Flag			•	1 gal	sun
Bouteloua gracilis 'Blonde Ambition'	Blonde Ambition Blue Grama Grass	•			1 gal	sun
Cotoneaster 'Emerald Carpet'	Willow Leaved Cotoneaster	•			1 gal	sun
Equisetum hyemale	Horsetail			•	1 gal	sun
Juncus inflexus 'Blue Arrows'	Blue Arrows Rush			•	1 gal	sun
Juncus effusus	Common Rush			•	2" pot	sun
Muhlenbergia lindheimeri	Lindheimer's Muhly	•			1 gal	sun
Panicum virgatum 'Shenandoah'	Shenandoah Switch Grass	•			1 gal	sun / part sun
Rhynchospora colorata	Whitetop Sedge			•	1 gal	sun / part shade
Schizachyrium scoparium 'Prairie Munchkin'	Dwarf Little Bluestem		•		1 gal	sun
Sorghastrum nutans	Indian Grass			•	1 gal	sun
Sporobolus heterolepis 'Tara'	Dwarf Prairie Dropseed	•	•		1 gal	sun
Sporobolus heterolepis	Prairie Dropseed	•			1 gal	sun

PAVING
SIDEWALK

FRONTAGE **B**

PRODUCT INFO

MANUFACTURER:
Endicott Clay Products Co.
PRODUCT NAME:
4"x8" Pedestrian/Light Vehicular Pavers (ASTM C902)
PRODUCT #/CODE:
N/A
COLOR:
Manganese Ironspot
FINISH/TEXTURE:
Wirecut
PATTERN:
Concrete Field with Soldier Course of Manganese Ironspot Edging

PLACEMENT:

SIDEWALK:
Public sidewalks between roadways and building facades

NOTES:

Depth of Pavers as per manufacturers recommendation based on loading requirements.

Concrete field to be installed at a depth and profile based on loading requirements.

Soldier course rowlock edging to have sand swept joints in mortar setting bed.

Install pavers in accordance with manufacturer's instructions and in proper relationship with adjacent construction.

PAVING
MAJOR CROSSINGS

FRONTAGE B

PRODUCT INFO

MANUFACTURER:
Ennis Flint
PRODUCT NAME:
DuraTherm Thermoplastic TrafficScape
PRODUCT #/CODE:
32W-08 (8')
COLOR:
White
PATTERN:
Wheels
8"-12" continuous edge border
Typical width of 8'

PLACEMENT:

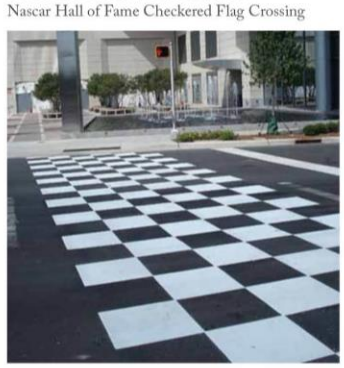
CROSSWALK:
Frontage intersection B/B
Frontage intersection A/B external to the district

NOTES:

Custom Crosswalk Designs may be implemented at culturally significant intersections as approved by Chapel Hill Planning Staff

Crosswalk widths and placement in relation to intersection must meet all Town of Chapel Hill standards

Example of Acceptable Alternative:
CUSTOM CROSSWALK DESIGN
Nascar Hall of Fame Checkered Flag Crossing



PAVING
MINOR CROSSINGS

FRONTAGE **B**

PRODUCT INFO

MANUFACTURER:
Endicott Clay Products Co.
PRODUCT NAME:
4"x8" Heavy Vehicular Pavers (ASTM C1272)
PRODUCT #/CODE:
COLOR:
Dark Ironspot
FINISH/TEXTURE:
Wirecut
PATTERN:
Running bond brick paver field
Min 8" Concrete edging bands contain brick field

PLACEMENT:

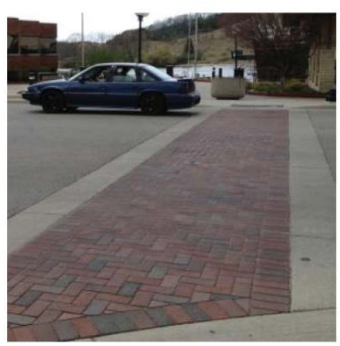
DRIVE CROSSINGS
Where private drives or alleys cross the sidewalk in the public right of way

NOTES:

Depth of Pavers as per manufacturers recommendation based on loading requirements.

Install pavers in accordance with manufacturer's instructions and in proper relationship with adjacent construction.

Heavy vehicular rating required for concrete bands



LANDSCAPE
INFILTRATION GARDENS

FRONTAGE B

PRODUCT INFO

MANUFACTURER:
Custom
PRODUCT NAME:
Infiltration Garden
PRODUCT #/CODE:
N/A
COLOR:
N/A
FINISH/TEXTURE:
Concrete
PATTERN:
Concrete curbs surround a linear planting area that incorporated modified soils and specific plantings for stormwater treatment
Raised concrete curb with breaks for stormwater collection

PLACEMENT:

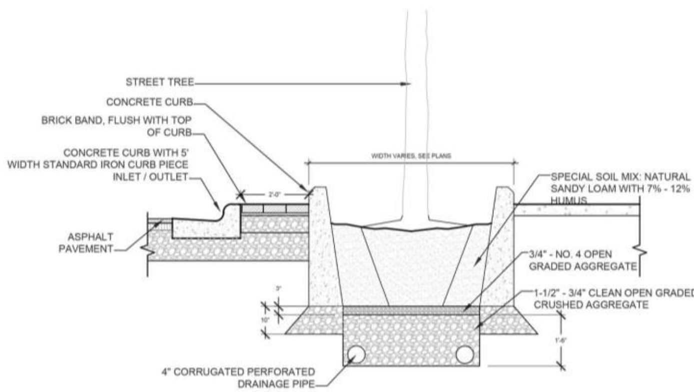
PLANTING ZONE
Continuous for length of street providing breaks where pedestrians and access is required
Used at bulb-outs where pedestrians do not cross street

NOTES:

Infiltration gardens shall receive all stormwater for length of street

Stalite shall be the standard planting medium for infiltration gardens

Outside public right-of-way only
(Optional)



PAVING
SIDEWALK

FRONTAGE **C**

PRODUCT INFO

MANUFACTURER:

PRODUCT NAME:
Concrete Sidewalk
PRODUCT #/CODE:
N/A
COLOR:
N/A
FINISH/TEXTURE:
Wire brush finish
PATTERN:
Minimum width of 6' with score joint 8" from each edge of walkway running parallel from walkway edge with control joints spaced at intervals equal to the distance between the 2 score joints

PLACEMENT:

SIDEWALKS/MULTI-USE PATHS:
Along street to allow for pedestrian movement; may also be used for bicycle circulation if path is installed at a width appropriate for a mixed use path.

NOTES:

Concrete must be a minimum of 3000PSI

Concrete field to be installed at a depth and profile based on loading requirements.

Saw cut all joints, tool joints not permitted

Chapter 4
Stormwater Management

4.1 GENERAL

Development and redevelopment within the Town's municipal boundaries and its Extraterritorial Jurisdiction (ETJ) are required to manage stormwater in accordance with Section 5.4 of the Chapel Hill Land Use Management Ordinance (LUMO.

The LUMO requires development and redevelopment activities to manage and control stormwater runoff rate, volume, pollutants, and erosion/sedimentation in order to protect and safeguard the environment, property, and safety of residents within the Town's jurisdiction. Low Impact Design (LID) measures are highly encouraged to meet the stormwater management performance criteria in the LUMO; the goal is to maintain a site's predevelopment (or improve redevelopment) hydrologic conditions utilizing ecologically-based management techniques that infiltrate, filter, store and evapotranspirate stormwater on-site.

This section of the Design Manual provides information about the design and acceptable techniques and controls to comply with the requirements of the LUMO. Acceptable stormwater management practices include those found in this Design Manual and in the most recent addition of the North Carolina Department of Environmental Quality *Stormwater Best Management Practices Manual*. The Town reserves the right to modify, amend, restrict, or otherwise change these accepted practices as may be necessary to achieve stated stormwater management goals. Any modifications or restrictions shall be noted in this chapter.

As part of the permit application process, the applicant is required to submit the methodology and accompanying calculations for the design solutions proposed within the stormwater management plan. Calculations shall be provided for all proposed stormwater infrastructure including, but not limited to, culverts, piped storm drainage systems, inlets, ditches, open channels, IMPs /SCMs outlet protection, etc.—and shall be sealed and signed by a registered design professional.

4.2 STORMWATER MANAGEMENT DESIGN CRITERIA

The stormwater management design criteria are contained in Subsection 5.4.6 of the Town's LUMO. A summary of these requirements is below.

WATER QUALITY: Stormwater treatment must achieve **85% Total Suspended Solids** (TSS) average annual removal. This removal rate is applied to the post-development runoff from the first one-inch (1") of precipitation.

> **STAFF NOTE**: The 85% TSS treatment requirement can be achieved by meeting the Minimum Design Criteria (MDC) for Primary SCMs in the NCDEQ Stormwater Design Manual.

VOLUME: The post-development runoff volume shall not exceed the pre-development runoff volume for the local 2-year, 24-hour storm.

> **STAFF NOTE:** The post development runoff volume requirement may be met by retaining the increased volume of stormwater runoff for a minimum of 2 days, but no longer than 5 days.

FLOW RATE: Post-development peak discharge flow rate cannot exceed pre-development peak discharge flow rate for the 1-year, 2-year, and 25-year, 24-hour storms from the site.

> **STAFF NOTE**: Post-development peak discharge flow rate must be evaluated for each property boundary discharge point as well as for the overall site.

LAND DISTURBANCE: Disturbance of any stream channel shall be prohibited unless explicitly authorized by issuance of a Zoning Compliance Permit after demonstration of the necessity for the disturbance. If stream channel disturbance is authorized, it shall be minimized to the extent practicable.

> **STAFF NOTE:** The implementation of the Jordan Lake Rules in Section 5.19 of the LUMO are currently delayed. However, for future nutrient accounting purposes, the Jordan Lake Accounting Tool output is required with the Stormwater Management Plan.

4.3 BASIS OF STORMWATER MANAGEMENT DESIGN

Hydrologic design includes evaluating the impacts that development has on stormwater runoff. The evaluation involves selecting the required design storm and using accepted hydrologic methodology to design storm drainage infrastructure, stream crossings, detention/retention facilities, etc. as necessary to meet applicable requirements and the performance standards of the Town's Land Use Management Ordinance. Designers must evaluate the impacts of proposed stormwater management practices both on-site and on adjacent properties, structures, and roadways.

Integrated Management Practices/Structural Control Measures

LUMO Subsection 5.4.7 requires applicants to use Integrated Management Practices/Structural Control Measures. "Integrated Management Practices" is a term that generally refers to the Structural Control Measures (SCM) used for stormwater management in a Low Impact Design (LID) project.

The stormwater goals of LID are to maintain groundwater recharge and quality; reduce stormwater pollutant loadings; protect stream channels; and prevent increased flooding. This can be accomplished by providing multi-functional stormwater controls that are decentralized and disconnected to the extent practicable.

Some examples of structural LID measures are bio-retention basins, infiltration structures, filter strips, permeable pavement, and green roofs.

Non-structural LID measures include site fingerprinting; minimizing the area of land disturbance; reducing impervious area; maintaining natural riparian buffers and vegetation; and prohibiting direct connections of site drainage to streams.

Drainage Areas

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

The pre- and post-development drainage area maps must clearly delineate the areas that are being directed to each analysis point/SCM, and identify the corresponding areas, runoff values and time of concentration (T_c) flow paths and flow types (sheet, shallow concentrated, channel, etc., unless the post-developed T_c is assumed to be 5 minutes).

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

Hydrologic Soil Groups (HSG)

Infiltration rates of soils vary widely and are affected by subsurface permeability as well as surface intake rates. Soils are classified into four HSG's (A, B, C, and D) according to their minimum infiltration rate, which is obtained for bare soil after prolonged wetting. The soils in the area of interest may be identified from a soil survey report, which can be obtained from local SCS offices, local soil and water conservation district office, the USDA NRCS Web Soil Survey or another reputable source. A copy of the soils report for the entire drainage should be included within the submittal. SCMs reliant upon infiltration rates for functionality will require that the underlying soils are tested (confirmation of hydraulic conductivity, K_{sat}) and a geotechnical/soils report submitted.

Most urban areas are only partially covered by impervious surfaces: the soil remains an important factor in runoff estimates. Urbanization has a greater effect on runoff in watersheds with soils having high infiltration rates (sands and gravels) than in watersheds predominantly of silts and clays, which generally have low infiltration rates. Any disturbance of a soil profile can significantly change its infiltration characteristics. With urbanization, native soil profiles may be mixed or removed or fill material from other areas may be introduced.

Cover types include vegetation, bare soil, and impervious surfaces. There are a number of methods for determining cover type. The most common are field reconnaissance, aerial photographs, and land use maps.

Hydrologic condition indicates the effects of cover type and treatment on infiltration and runoff and is generally estimated from density of plant and residue cover on sample areas. *Good* hydrologic condition indicates that the soil usually has a low runoff potential for that specific hydrologic soil group. Cover type, and treatment. Some factors to consider in estimating the effect of cover on infiltration and runoff are (a) canopy or density of lawns, crops or other vegetative areas; (b) amount of year-round cover; (c) amount of grass or close-seeded legumes in rotations; (d) percent of residue cover; and (e) degree of surface roughness.

Hydrologic Methodology

Hydrologic (quantity) methodology includes estimating peak runoff rates, volumes and time distributions (discharge per unit of time) as a result of precipitation. The most commonly recognized methods for determining the relationship between rainfall and runoff is the SCS Method and the Rational Method. Other analytical tools may be approved by the Town's Stormwater Management Division if properly substantiated.

The Rational Method for determining peak runoff rates of discharge is appropriate only for drainage areas that do not exceed 10 acres. The SCS Method should be utilized to determine peak runoff rates for drainage areas that exceed 10 acres. The corresponding C, CN, and hydrologic soil groups for soil types must utilize the information provided within the current edition of the *NCDEQ Stormwater Design Manual* , published by the North Carolina Department of Environmental Quality. The Stormwater Management Division may require use of adjusted curve numbers for developments which can be expected to differ significantly from the typical values shown for the impervious area percentages.

SCS Method

The SCS method requires basic data similar to the Rational Method. The SCS Method approach, however, is more sophisticated in that it also considers the time distribution of the rainfall, the initial rainfall losses to interception and depression storage, and an infiltration rate that decreases during the course of a storm. Details of the methodology can be found in the *USDA NRCS Urban Hydrology for Small Watersheds*.

Peak discharge and volume calculations shall be based on a Type-II precipitation distribution. Total runoff depth using SCS equations, curves, and the appropriate depth-duration-frequency and intensity-duration-frequency values, which are provided in Table 4.5 and Table 4.6, respectively.

The SCS runoff equation is:

$$Q = \frac{(P-I_a)^2}{(P-I_a)+S} \qquad \text{[Eq. 4-1]}$$

Where: *Q = runoff (in)*
P = rainfall (in)
S = potential maximum retention after runoff begins (in)
I_a *= initial abstraction (in)*

Initial abstraction (I_a) is all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. I_a is highly variable but generally is correlated with soil and cover parameters. Through studies of many small agricultural watersheds, I_a was found to be approximated by the following empirical equation:

$$I_a = 0.2S \qquad \text{[Eq. 4-2]}$$

By removing I_a as an independent parameter, this approximation allows use of a combination of *S* and *P* to produce a unique runoff amount. Substituting equation 4-2 into equation 4-1 gives:

$$Q = \frac{(P-0.2S)^2}{(P+0.8S)} \qquad \text{[Eq. 4-3]}$$

S is related to the soil and cover conditions of the watershed through the CN. CN has a range of 0 to 100, and *S* is related to CN by:

$$S = \frac{1000}{CN} - 10 \qquad \text{[Eq. 4-4]}$$

Hydrology: A branch of science that determines the amount of water (water quantity or discharge) that will run off as a result of precipitation. The hydrology will be affected by the amount, frequency, and duration of the precipitation, the land cover, soils, the watershed shape and slope, and amount of storage available in the watershed.

Hydraulics: A branch of science that studies the practical applications of water in motion. Combines the watershed hydrology with cross section data to estimate the depth and area of water.

Figure 4.1 - Solution of the SCS Runoff Equation

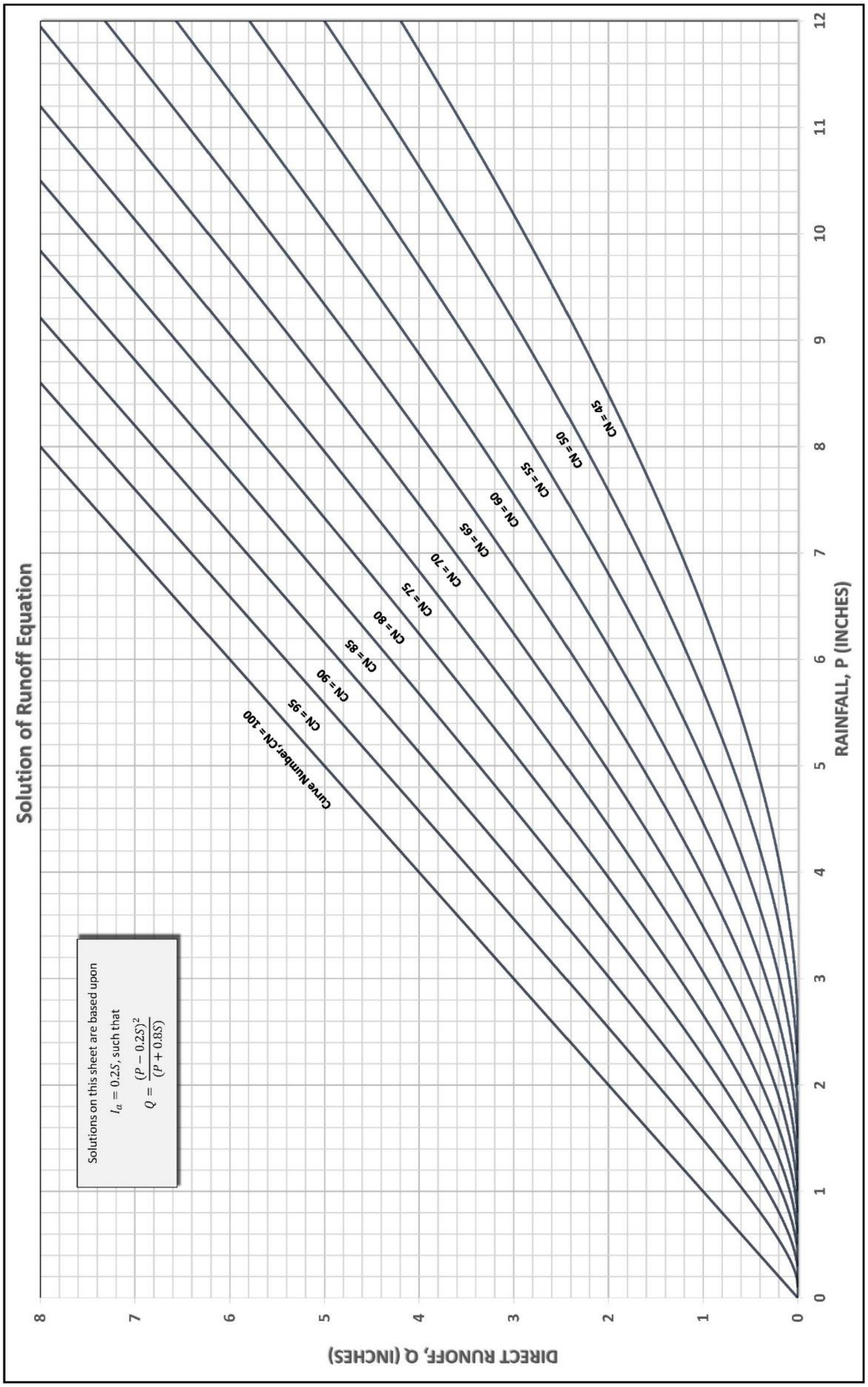


Figure 4.2

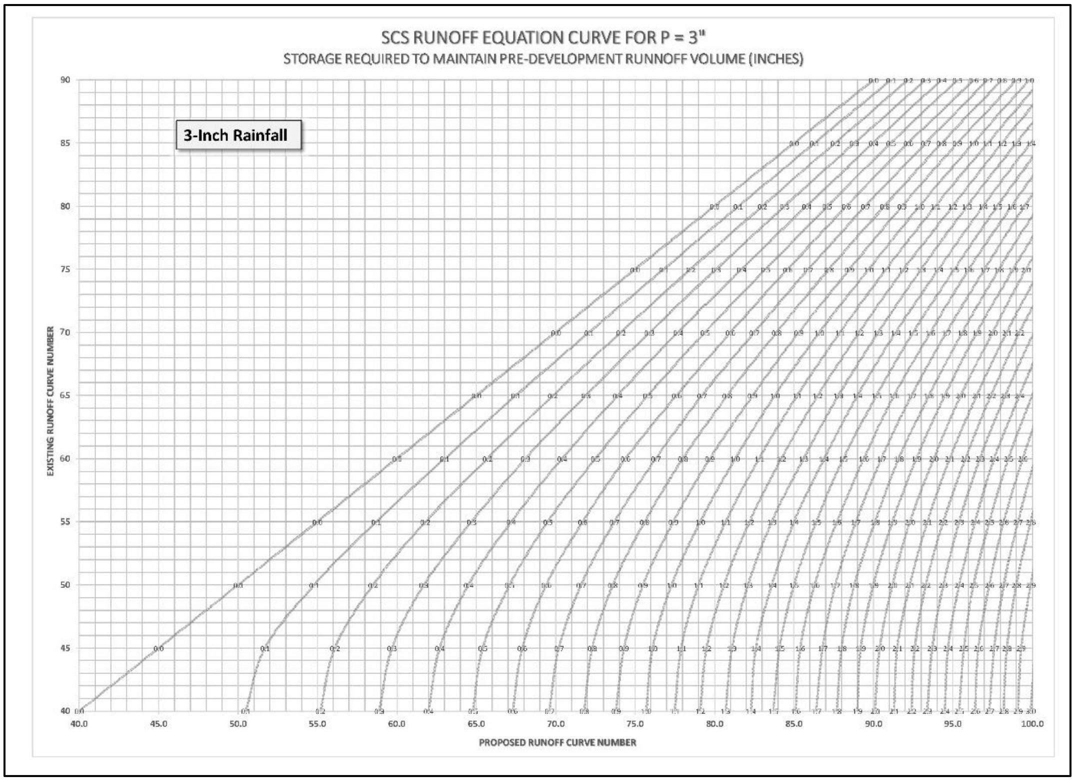


Figure 4.3

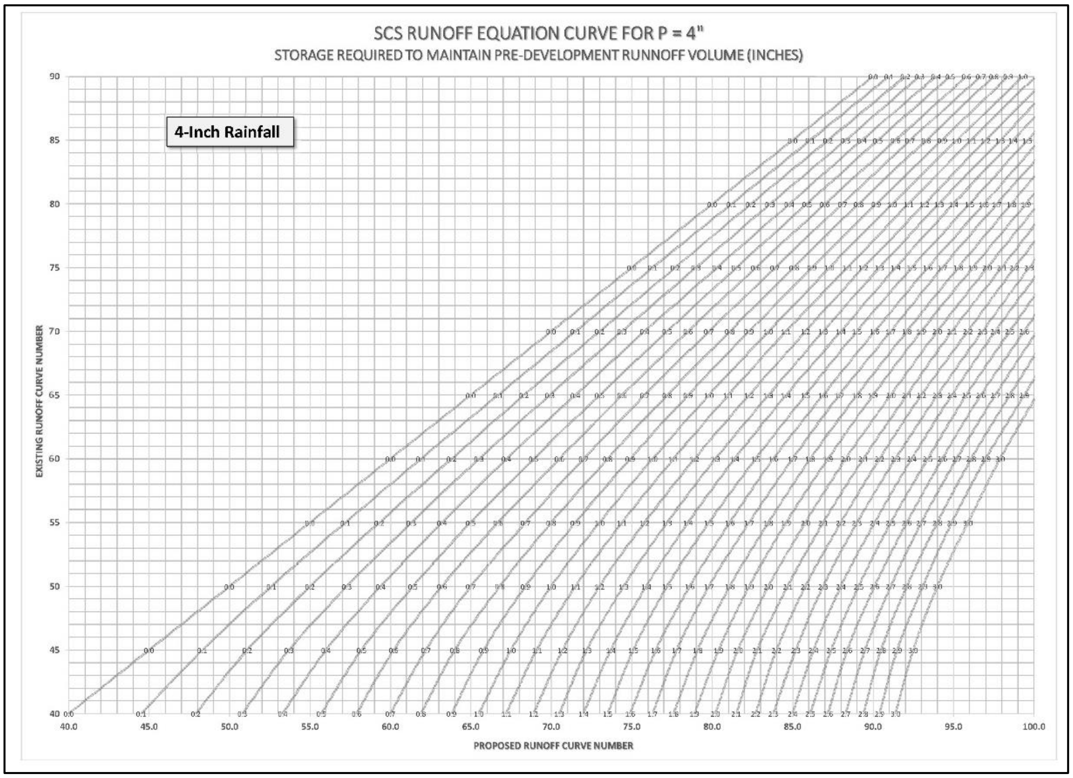


Table 4.1 – Runoff Depths

Rainfall	Runoff depth (inches) for curve number of—												
	40	45	50	55	60	65	70	75	80	85	90	95	98
1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.08	0.17	0.32	0.56	0.79
1.2	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.07	0.15	0.27	0.46	0.74	0.99
1.4	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.13	0.24	0.39	0.61	0.92	1.18
1.6	0.00	0.00	0.00	0.00	0.01	0.05	0.11	0.20	0.34	0.52	0.76	1.11	1.38
1.8	0.00	0.00	0.00	0.00	0.03	0.09	0.17	0.29	0.44	0.65	0.93	1.29	1.58
2.0	0.00	0.00	0.00	0.02	0.06	0.14	0.24	0.38	0.56	0.80	1.09	1.48	1.77
2.5	0.00	0.00	0.02	0.08	0.17	0.30	0.46	0.65	0.89	1.18	1.53	1.96	2.27
3.0	0.00	0.02	0.09	0.19	0.33	0.51	0.71	0.96	1.25	1.59	1.98	2.45	2.77
3.5	0.02	0.08	0.20	0.35	0.53	0.75	1.01	1.30	1.64	2.02	2.45	2.94	3.27
4.0	0.06	0.18	0.33	0.53	0.76	1.03	1.33	1.67	2.04	2.46	2.92	3.43	3.77
4.5	0.14	0.30	0.50	0.74	1.02	1.33	1.67	2.05	2.46	2.91	3.40	3.92	4.26
5.0	0.24	0.44	0.69	0.98	1.30	1.65	2.04	2.45	2.89	3.37	3.88	4.42	4.76
6.0	0.50	0.80	1.14	1.52	1.92	2.35	2.81	3.28	3.78	4.30	4.85	5.41	5.76
7.0	0.84	1.24	1.68	2.12	2.60	3.10	3.62	4.15	4.69	5.25	5.82	6.41	6.76
8.0	1.25	1.74	2.25	2.78	3.33	3.89	4.46	5.04	5.63	6.21	6.81	7.40	7.76
9.0	1.71	2.29	2.88	3.49	4.10	4.72	5.33	5.95	6.57	7.18	7.79	8.40	8.76
10.0	2.23	2.89	3.56	4.23	4.90	5.56	6.22	6.88	7.52	8.16	8.78	9.40	9.76
11.0	2.78	3.52	4.26	5.00	5.72	6.43	7.13	7.81	8.48	9.13	9.77	10.39	10.76
12.0	3.38	4.19	5.00	5.79	6.56	7.32	8.05	8.76	9.45	10.11	10.76	11.39	11.76
13.0	4.00	4.89	5.76	6.61	7.42	8.21	8.98	9.71	10.42	11.10	11.76	12.39	12.76
14.0	4.65	5.62	6.55	7.44	8.30	9.12	9.91	10.67	11.39	12.08	12.75	13.39	13.76
15.0	5.33	6.36	7.35	8.29	9.19	10.04	10.85	11.63	12.37	13.07	13.74	14.39	14.76

**Note: Interpolate the values shown to obtain runoff depths for CN's or rainfall amounts not shown.*

Factors considered in determining runoff curve numbers

The major factors that determine Curve Numbers (CN) are the hydrologic soil group (HSG), cover type, treatment, hydrologic condition, and antecedent runoff condition. Another factor considered is whether impervious areas outlet directly to the drainage system (connected) or whether the flow spreads over pervious areas before entering the drainage system (unconnected). Table 4.2 is provided to aid in selecting the appropriate figure or table for determining curve numbers.

Table 4.2 - Runoff Curve Numbers

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area[2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1 Average runoff condition, and $I_a = 0.2S$.

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Time of Concentration

Travel time (T_t) is the time it takes water to travel from one location to another in a watershed. T_t is a component of time of concentration (T_c) which is the time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. T_c is computed by summing all the travel times for consecutive components of the drainage conveyance system.

T_c influences the shape and peak of the runoff hydrograph. Urbanization usually decreases T_c, thereby increasing the peak discharge. But Tc can be increased as a result of (a) ponding behind small or inadequate drainage systems, including storm drain inlets and road culverts, or (b) reduction of land slope through grading.

The Land Use management Ordinance (LUMO) states that for the 1-, 2- and 25-year peak discharges, the **24-hour duration** event must be considered. This statement was assuming that the method to generate the peak discharges was the **SCS Method**, not the Rational Method.

Factors affecting time of concentration and travel time

Surface roughness – One of the most significant effects of urban development on flow velocity is less retardance to flow. That is, undeveloped areas with very slow and shallow overland flow through vegetation become modified by urban development; the flow is then delivered to streets, gutters, and storm sewers that transport runoff downstream more rapidly. Travel time through the watershed is generally decreased.

Channel shape and flow patterns – In small non-urban watersheds, much of the travel time results from overland flow in upstream areas. Typically, urbanization reduces overland flow lengths by conveying storm runoff into a channel as soon as possible. Since channel designs have efficient hydraulic characteristics, runoff flow velocity increases and travel time decreases.

Slope – Slopes may be increased or decreased by urbanization, depending on the extent of site grading or the extent to which storm sewers and street ditches are used in the design of the water management system. Slope will tend to increase when channels are straightened and decrease when overland flow is directed through storm sewers, street gutters, and diversions.

Computation of travel time(s) and time of concentration

Water moves through a watershed as sheet flow, shallow concentration flow, open channel flow, or some combination of these. The type that occurs is a function of the conveyance system and is best determined by field inspection.

Travel time (T_t) is the ratio of flow length to flow velocity:

$$T_t = \frac{L}{3600V} \qquad \text{[Eq. 4-5]}$$

Where: *T_t = travel time (hr)*
L = flow length (ft)
V = average velocity (ft/s)
3600 = conversation factor from seconds to hours

Time of concentration (T_c) is the sum of T_t values for the various consecutive flow segments:

$$T_c = T_{t1} + T_{t2} + \dots T_{tm} \qquad \text{[Eq. 4-6]}$$

Where: T_c = *time of concentration (hr)*
m = number of flow segments

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

Sheet Flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks: and erosion and transportation of sediment. These n values are for very shallow flow depths of about 0.1 foot. Table 4.3 gives Manning's n values for sheet flow for various surface conditions. Pre-development wooded areas must be assumed to be woods, dense underbrush; n = 0.80, unless can be proven otherwise.

For flow length, use the following:

Pre-development: Minimum of 100 feet, Maximum of 300 feet.

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

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overton and Meadows 1976) to compute T_t:

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} s^{0.4}} \qquad \text{[Eq. 4-7]}$$

Where: T_t = *travel time (hr.)*
n = Manning's roughness coefficient
L = flow length (ft.)
P_2 = *2 year, 24-hour rainfall (in), and*
s = slope of hydraulic grade line (land slope, ft/ft).

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (than part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time.

Table 4.3 - Roughness coefficients (Manning's n) for sheet flow

Surface Description	n[1]
Smooth surfaces (concrete, asphalt, gravel or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils	
Residue cover ≤ 20%	0.06
Residue cover > 20%	0.17
Grass	
Short grass prairie	0.15
Dense grasses[2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods[3]	
Light underbrush	0.4
Dense underbrush	0.8

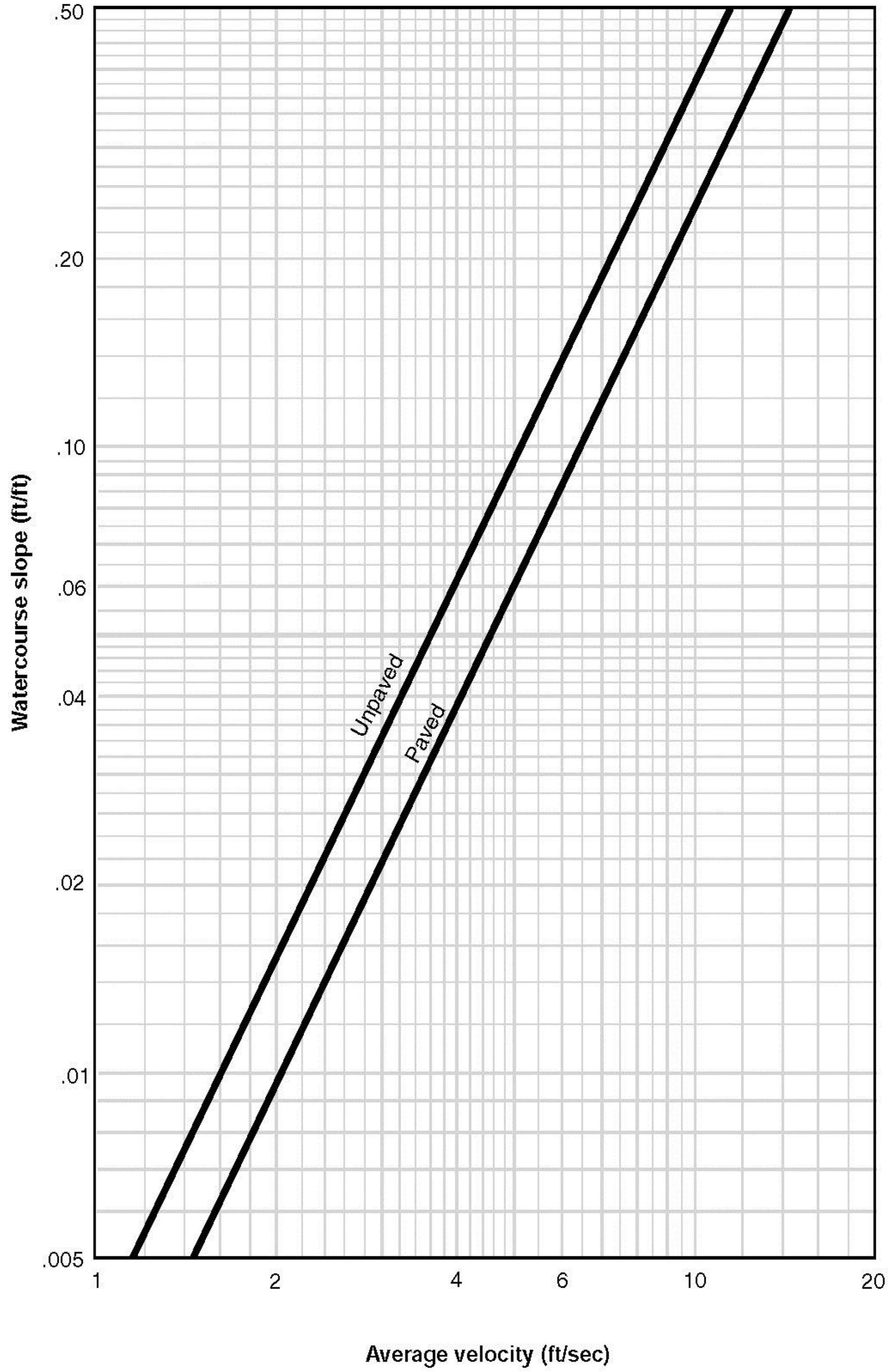
1 - The n values are a composite of information compiled by Engman (1986).
2 - Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
3 - When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

Shallow concentrated flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from *Figure 4.4 – Average Velocities for Estimating Travel Time for Shallow Concentrated Flow*, in which average velocity is a function of watercourse slope and type of channel. Tillage can affect the direction of shallow flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in, use equation 4-5 to estimate travel time for the shallow concentrated flow segment.

Figure 4.4
Average Velocities for Estimating Travel Time for Shallow Concentrated Flow



(210-VI-TR-55, Second Ed., June 1986)

Channelized Flow

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full elevation.
Manning's equation is:

$$V = \frac{1.49}{n}(R^{2/3})(S^{1/2}) \qquad \text{[Eq. 4-8]}$$

Where: V = average velocity (ft/s)
r = hydraulic radius (ft) and is equal to a/P_w
a = cross sectional flow area (ft^2)
P_w = wetted perimeter (ft)
s = slope of the HGL (channel slope, ft/ft)
n = Manning's roughness coefficient for open channel flow

Manning's n values for open channel flow can be obtained from standard textbooks such as Chow (1950) or Linsley et al. (1982). After average velocity is computed using equation 4-8, Tt for channel segment can be established using equation 4-5.

Reservoirs or lakes

Sometimes it is necessary to estimate the velocity of flow through a reservoir or lake at the outlet of a watershed. This travel time is normally very small and can be assumed as zero.
Limitations

Manning's kinematic solution should not be used for sheet flow longer than 300 feet. Equation 3-3 was developed for use with the four standard rainfall intensity-duration relationships.

In watersheds and storm sewers, carefully identify the appropriate hydraulic flow path to estimate Tc. Storm sewers generally handle only a small portion of a large event. The rest of the peak flow travels by streets, lawns, and so on, to the outlet. Consult a standard hydraulics textbook to determine average velocity in pipes for either pressure or non-pressure flow.

A culvert or bridge can act as a reservoir outlet if there is significant storage behind it. The procedures in TR-55 can be used to determine the peak flow upstream of the culvert. Detailed storage routing procedures should be used to determine the outflow through the culvert.

The **Rational Method** considers time of concentration for the selection of the storm duration and the rainfall intensity. It cannot be used with a prescribed duration of 24 hours. The result will be inaccurate and much less peak discharge generation for both pre and post-development conditions will result, which will lead to poor design practices. Most storm events in small catchments cause a peak discharge in a much less timeframe than 24-hours, such as **5 minutes**.

Kirpich's equation (1940) was developed for small, agricultural watersheds. It was derived by examining the required time for the stream to rise from low to maximum stage during a storm. The time of concentration was then assumed equal to that time. This equation (left) was developed for overland flow on bare earth; T_c for flows over other surfaces must be adjusted accordingly.

Rational Method

For catchments up to and including 10 acres, the Rational Method may be used to calculate peak discharges for storm events, unless site specific circumstances dictate that hydraulic routing and hydrograph generation are necessary such as multiple drainage basins routed to a common point of analysis within the project area.

The following procedure should be followed for Rational Method analyses:

(1) Determine the watershed size in acres (ac) to the point of discharge.

(2) Time of Concentration (Tc) estimates shall utilize the Kirpich Equation, below.

$$T_C = \frac{(L^3/H)^{0.385}}{128} \quad \text{[Eq. 4-9]}$$

Where: *T_c = Time of concentration, in minutes*
L = Longest flow path, in feet
H = Elevation of difference along L, in feet

NOTE: *The following adjustments for T_c must be made.*
For well-defined natural channels use T_c x 1
For overland flow on grassy surfaces use T_c x 2
For overland flow on paved surfaces use T_c x 0.4
For concrete channels use T_c x 0.2

(3) Determine the rainfall intensity (I) using the appropriate intensity-duration frequency table found in (provided in Table 4-6).

NOTE: For the 1-yr.storm, use 80% of the 2-year storm peak discharge, or the following equation, to calculate intensity:

$$i = \frac{g}{(h+T)} \quad \text{[Eq. 4-10]}$$

Where: i = Rainfall intensity (in/hr)
T = Time of duration (min)
G = 104 (empirically derived constant)
h = 18 (empirically derived constant)

(4) Determine the composite runoff coefficient (*C_{comp}*) using Eq. 4-11 and Table 4.4, below.

$$C_{comp} = \frac{\sum (C_{Individual\ Area})(A_{Individual\ Area})}{A_{Total\ Area}} \quad \text{[Eq. 4-11]}$$

Table 4.4 - Rational Runoff Coefficients

Description	C	Source
Roof, inclined	0.96	Malcom, 2003
Street, driveway, sidewalk, parking lot	0.96	Malcom, 2003
Gravel	0.90	T.O.C.H.
Commercial, generalized	0.90	Malcom, 2003
Apartments, schools, churches	0.84	Malcom, 2003
Residences, 10 dwellings/acre	0.80	T.O.C.H.
Residences, 6 dwellings/acre	0.60	T.O.C.H.
Residences, 4 dwellings/acre	0.74	Malcom, 2003
Residences, 2 dwellings/acre	0.70	Malcom, 2003
Unimproved cleared area	0.50	T.O.C.H.
Lawn, dense soil, steep >7%	0.60	Malcom, 2003
Lawn, dense soil, avg 2-7%	0.50	T.O.C.H.
Lawn, dense soil, flat 2%	0.20	T.O.C.H.
Lawn, sandy ≥ 2%	0.15	Chow, 1964
Lawn, sandy, flat <2%	0.10	Chow, 1964
Wooded, deep ground litter	0.40	Malcom, 2003
Wooded, sparse ground litter	0.40	T.O.C.H.
Porous Asphalt	0.30	T.O.C.H.
Park, cemetery	0.50	T.O.C.H.
Playground	0.60	Malcom, 2003

(5) Apply the Rational Equation for the applicable pre/post-development condition and storm frequency.

$$Q = CiA \qquad \text{[Eq. 4-12]}$$

Where: *Q = Peak flow in cubic feet per second (cfs)*
C = Runoff coefficient to reflect the ratio of rainfall to surface runoff
i = Rainfall intensity in inches per hour (in/hr)
A = Drainage area in acres (ac)

Precipitation Estimates

The analysis shall utilize point precipitation frequency estimates from NOAA Atlas 14, for the CHAPEL HILL 2 W (31-1677) NC station for precipitation data.

Table 4.5 - Depth-Duration-Frequency

Duration	Average Recurrence Interval						
	1-Year (inches)	2-Year (inches)	5-Year (inches)	10-Year (inches)	25-Year (inches)	50-Year (inches)	100-Year (inches)
5 minutes	0.411	0.48	0.56	0.62	0.68	0.72	0.76
10 minutes	0.657	0.77	0.89	0.98	1.08	1.14	1.20
15 minutes	0.821	0.97	1.13	1.25	1.37	1.45	1.52
30 minutes	1.13	1.35	1.61	1.80	2.02	2.18	2.33
60 minutes	1.40	1.69	2.06	2.35	2.69	2.95	3.20
2 hours	1.68	2.03	2.49	2.87	3.33	3.70	4.05
3 hours	1.79	2.16	2.66	3.08	3.61	4.04	4.46
6 hours	2.15	2.59	3.20	3.71	4.37	4.92	5.47
12 hours	2.54	3.06	3.80	4.44	5.28	5.99	6.71
24 hours	2.96	3.58	4.47	5.17	6.11	6.86	7.62

Table 4.6 - Intensity-Duration Frequency Data

Duration	Average Recurrence Interval						
	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)
5 minutes	4.93	5.81	6.70	7.38	8.11	8.62	9.07
10 minutes	3.94	4.64	5.36	5.90	6.46	6.86	7.21
15 minutes	3.28	3.89	4.52	4.98	5.46	5.79	6.07
30 minutes	2.25	2.69	3.21	3.61	4.04	4.36	4.65
60 minutes	1.40	1.69	2.06	2.35	2.69	2.95	3.20
2 hours	0.838	1.01	1.25	1.43	1.66	1.85	2.03
3 hours	0.595	0.72	0.89	1.03	1.20	1.34	1.48
6 hours	0.359	0.43	0.53	0.62	0.73	0.82	0.91
12 hours	0.211	0.25	0.32	0.37	0.44	0.50	0.56
24 hours	0.123	0.15	0.19	0.22	0.26	0.29	0.32

4.4 STORMWATER DRAINAGE SYSTEM

For the purposes of this section “storm drainage systems” include engineered infrastructure designed to safely and effectively receive, convey, and discharge stormwater runoff within Town’s planning jurisdiction. Drainage facilities must be designed to control/convey stormwater runoff resulting from all storm events up to and including the design storm as noted in Table 4.7.

Streets

The stormwater management and storm drainage infrastructure shall be designed such that:

(1) Streets will not be flooded as a result of stormwater runoff from the applicable design storm.

(2) Backwater will not exceed the boundaries of storm drainage easements or rights-of-way.

(3) Structures and/or property located outside of drainage easements or regulatory floodplains will not be flooded.

(4) When checking spread requirements at sag points (0% slope) check spread upstream of sags (at the 0.5% slope point) to verify spread is not exceeded. Additional flanking inlets upstream may need to be added to keep spread criteria from being exceeded at these points.

(5) Ponding at yard inlets outside the roadway shall be limited to a maximum of one foot above a grated inlet for the 10-year storm.

(6) No concentrated runoff flowing over Town sidewalks.

(7) Roadside ditches, when allowed, shall be a minimum of 18 inches deep and shall provide the capacity designed for a 10-year storm. For subdivision streets ditch flow for the 25-year storm shall not encroach onto the pavement. For thoroughfare streets ditch flow for the 50-year storm shall not encroach onto the pavement. Exceptions due to grading constraints may be granted by the Town on a case-by-case basis.

(8) For subdivision streets the driveway and culvert shall be designed such that the flow from a 25-year storm shall not encroach onto the roadway pavement. For thoroughfare streets the driveway and culvert shall be designed such that the flow from a 50-year storm shall not encroach onto the roadway pavement.

Table 4-7 lists return periods for determining design storm discharges for different types of street facilities. The analysis should demonstrate that the surcharge or overflow discharge will be conveyed in a controlled manner and will not cause a public health or safety risk.

Table 4.7 - Design Storms for Streets

Facility*	**Design storm** (NRCS 24-hour duration)
Arterial Roadways	25 yr.
Collector Roadways	25 yr.
Local Roadway	10 yr.

*In Regulatory Floodways, the Design Storm is the 100-year, 24-hour return period ; 2 feet of freeboard should also be provided for the 100-year, 24-hour storm. The Resource Conservation District provisions must be met also.

Note: Where conflicts exist between applicable State and Town design storm requirements, the more restrictive of the two shall govern.

The maximum stormwater spread widths allowed in Table 4-8 are not exceeded for the applicable street classification.

Table 4.8 - Maximum Allowable Stormwater Spread on Pavement

Street classification	**Maximum allowable spread**
Local	No curb over-topping, *flow spread must leave at least one dry 10 foot travel lane.
Collector and arterial	No curb over-topping, *flow spread must leave at least one dry 10 foot travel lane *in each direction*.

* Where no curbing exists, spread shall not extend outside of the public right-of-way.
(Reference: Wright-McLaughlin Engineers)

Street Inlets

(1) Street inlet spacing shall utilize a design storm intensity of 4 inches per hour. Gutter spread widths shall not exceed ½ the width of a travel lane, with an absolute maximum of 8 feet. In areas of heavy pedestrian traffic or alleys, the maximum allowable spread may be decreased by the Stormwater Management Division.

(2) Inlet bypass shall be limited to less than 0.10-cubic feet per second (cfs) into an intersection**.** Inlets on a continuous grade should be spaced to limit the spread of stormwater onto the pavement. The spacing of inlets is based on the allowable spread and the inlet capacity. The flow bypassing an inlet must be included in the flow arriving at the next inlet.

(3) Inlets should be placed at intersections and all low points in the gutter grade to prevent gutter flow from crossing traffic and pedestrian lanes of the intersecting road.

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

(5) A minimum of two inlets- double inlet) should be placed in the sag of vertical curves. The additional inlets provide extra capacity and a safety factor against potential street flooding if the inlets become clogged due to deposition of sediment and debris. This also reduces the flow arriving at the low point and thereby help reduce ponding which could flood the road.

(6) Inlet types shall be selected from the Town of Chapel Hill Standard inlet type or equivalent North Carolina State Department of Transportation standards on NCDOT Streets. Inlets shall be located or spaced in such a manner that the design curb flow does not exceed the spread limitations.

(7) Inlets on a continuous grade should be spaced to limit the spread of stormwater onto the pavement. The spacing of inlets is based on the allowable spread and the inlet capacity. The flow bypassing an inlet must be included in the flow arriving at the next inlet.

(8) Inlets are normally placed upstream of pedestrian crossings to intercept the gutter flow before it reaches the crosswalk. Where pavement surfaces are warped at cross streets, ramps, or transitions between super elevated and normal sections, gutter flow should be diverted into the storm drainage system to prevent water flow across the roadway. Where a curbed roadway crosses a bridge, gutter flow should be intercepted before it reaches the bridge.

Curb & Gutter

(1) Standard 30-inch curb-and-gutter is required in all cases, unless an alternative is approved by the Town Manager.

(2) The typical minimum longitudinal grade for curb & gutter is 2%.

(3) Spot grades or profiles shall be provided in cul-de-sacs to ensure positive drainage.

Gutter Flow Calculations

The following form of Manning's equation should be used to evaluate gutter flow hydraulics:

$$Q = \left[\frac{0.56}{n}\right] ST^{\frac{5}{3}} SL^{\frac{1}{2}} T^{\frac{8}{3}} \qquad \text{[Eq. 4-13]}$$

Where:

Q = Gutter flow rate (ft^3/sec)
n = Manning's roughness coefficient
ST = Pavement/roadway cross-slope (ft/ft)
SL = Longitudinal slope (ft/ft), Generally, this is equivalent to the roadway centerline profile.
T = Width of flow or spread (ft)
Note: Manning's n value for concrete curb and gutter is 0.016.

In tabular format, report the following:

- Inlet # – Assigned number (or label) of drainage structure.
- Drainage Area – Area contributing runoff to the inlet (acres).
- Surface 'Q' Sub, Q_{sub} – Flow (in cfs) from inlet sub-basin
- Inlet flow capacity, $Q_{inlet\ cap}$ – Flow (in cfs) capacity of the inlet
- Bypass flow, Q_{bypass} – Flow (in cfs) that is bypassed around the inlet
- Total gutter flow, Q*total* – All gutter flow (in cfs) at inlet

$$Q_{sub} = CiA \qquad \text{[Eq. 4-12]}$$

Where:

Q = Peak flow in cubic feet per second (cfs)
C = Runoff coefficient to reflect the ratio of rainfall to surface runoff
i = Rainfall intensity in inches per hour (in/hr) = 4.0 in/hr
A = Drainage Area in acres (ac)

$$Q_{inlet\ cap} = KD^{5/3} \qquad \text{[Eq. 4-15]}$$

Where:

$Q_{inlet\ cap}$ = Inlet Capacity (cfs)
K = Coefficient is used to determine the inlet capacity of a catch basin grate on grade.
D = ST x T, depth of flow at curb (ft)

ST = Pavement cross slope (ft/ft)
T = Width of flow or spread (ft) (refer to Table 4.8)

Example:

For a "normal crown" street, ST = 3/8" per 1' = 0.0313 ft/ft.

The maximum spread, T, is 10'. D = 0.0313 ft/ft x 10' = 0.313'

$$Q_{bypass} = Q_{sub} - Q_{inlet\ cap} \quad \text{[Eq. 4-16]}$$

Note/list the bypass destination

$$Q_{total} = Q_{sub} + \sum Q_{bypass} \quad \text{[Eq. 4-14]}$$

Note: Computer software for gutter flow analysis is acceptable. The computer printout should contain the same information as described above *(Inlet #, Drainage Area, Q_{sub}, Q_{bypass}, $Q_{inelt\ cap}$ and Q_{total},).*

Longitudinal Slope

A minimum longitudinal gradient is more important for a curbed pavement, since it is susceptible to stormwater spread. Flat gradients on uncurbed pavements can lead to a spread problem if vegetation is allowed to build up along the pavement edge.

Curb and gutter grades that are equal to pavement slopes shall not fall below 0.5 percent. Minimum grades can be maintained in very flat terrain by use of a sawtooth profile. For long vertical curves, cross slope may be varied slightly to achieve 0.5 percent minimum gutter grade.

Bridge Decks

Drainage of bridge decks is similar to other curbed roadway sections. Because of the difficulties in providing and maintaining adequate deck drainage systems, gutter flow from roadways should be intercepted before it reaches a bridge. In many cases, deck drainage must be carried several spans to the bridge end for disposal. Zero gradients and sag vertical curves should be avoided on bridges. The minimum desirable longitudinal slope for bridge deck drainage should be 1 percent. When bridges are placed at a vertical curve and the longitudinal slope is less than 1 percent, the gutter spread should be checked to ensure a safe, reasonable design. Scuppers are the recommended method of deck drainage because they can reduce the problems of transporting a relatively large concentration of runoff in an area of generally limited right-of-way. However, the use of scuppers should be evaluated for site-specific concerns. Scuppers should not be located over embankments, slope protection, navigation channels, driving lanes, or railroad tracks. Runoff collected and transported to the end of the bridge should generally be collected by inlets and down drains. For situations where traffic under the bridge or environmental concerns prevents the use of scuppers, grated bridge drains should be used.

Median Barriers

Weep holes are often used to prevent ponding of water against median barriers (especially on superelevated curves). In order to minimize flow across traveled lanes, it is preferable to collect the water into a subsurface system connected to the main storm drain system.

Open Channels

For open channels, the erosion potential of the soil shall be evaluated for the 10-year storm event. Channels and ditches shall be designed to carry the design flow at non-erosive velocities, and contain the design storm within the banks.

Surface flow and channel velocities shall not exceed 4 feet per second for the applicable design storm.

Appropriate measures shall be taken to protect the soil and/or reduce velocities to prevent erosion. The channel protection required to prevent erosion is determined by computing the velocity in the channel at the design discharge and comparing that velocity with the permissible value for the type of channel lining used.

Calculations indicating design velocities shall be provided along with typical channel cross-sections. The non-erosive velocities shall be based on the permanent cover and temporary lining proposed as per Table 8.05a in the North Carolina Erosion and Sediment Control Planning and Design Manual published by NCDEQ. The minimum slope for open channel systems (ditches, swales) shall be 2%.

- For maintenance and stability reasons, the maximum side-slope for open channels is 3:1.
- Riprap will not be allowed for stabilization within the street right-of-way (except as outlet protection on culverts).

Super elevation of the water surface at horizontal curves shall be accounted for by increased freeboard.

A minimum freeboard of 6” must be provided in the 10-year design storm.

Transition from closed systems to channel sections (or between transitioning channel sections) shall be smooth and gradual, with a minimum of 5:1 taper.

In addition to the design of roadside ditches, a design shall be provided for driveway culverts for each individual lot on the plan. The use of a small driveway culvert, 15-inches minimum diameter, in conjunction with overtopping of the driveway itself will be allowed as further described in the Culverts paragraph below. Sizes for all driveway culverts shall be shown in tabular form on the plans, and each culvert shall be designed for the highest ditch flow applicable for the lot.

Vegetated Open Channels

Vegetation is the most desirable lining for an artificial channel. It stabilizes the channel body, consolidates the soil mass of the bed, inhibits erosion on the channel surface, and controls the movement of soil particles along the channel bottom. Conditions under which vegetation may not be acceptable; however, include but are not limited to:

- Flow conditions in excess of the maximum shear stress for bare soils
- Standing or continuous flowing water
- Lack of regular maintenance necessary to prevent domination by taller vegetation
- Lack of nutrients and inadequate topsoil
- Excessive shade

- Excessive velocities

Proper seeding, mulching, and soil preparation are required during construction to ensure establishment of a healthy stand of grass. Soil testing may be performed and the results evaluated by an agronomist to determine soil treatment requirements for pH, nitrogen, phosphorus, potassium, and other factors. In many cases, temporary erosion control measures are required to provide time for the seeding to establish a viable vegetative lining.

Under continuous base flow conditions when a vegetative lining alone would be appropriate, a small concrete pilot channel could be used to convey the continuous low flows. Vegetation could then be maintained for conveying larger flows.

Open Channel Permissible Velocity Calculations

The permissible velocity procedure uses two equations to calculate flow:

Manning's equation,

$$V = \frac{1.49}{n}(R^{2/3})(S^{1/2}) \qquad \text{[Eq. 4-8]}$$

Where: V = average velocity (ft/s)
r = hydraulic radius (ft) and is equal to a/P_w
a = cross sectional flow area (ft^2)
P_w = wetted perimeter (ft)
s = slope of the HGL (channel slope, ft/ft)
n = Manning's roughness coefficient for open channel flow

And the continuity equation,

$$Q = AV \qquad \text{[Eq. 4-17]}$$

Where: Q = flow in the channel (cfs)
A = cross-sectional area of flow within the channel (ft^2)
V = average velocity in the channel (ft/sec)

Manning's equation and the continuity equation are used together to determine channel capacity and flow velocity.

Selecting Permanent Channel Lining

The design of concrete and similar rigid linings is generally not restricted by flow velocities. However, vegetative and flexible channel linings do have maximum permissible flow velocities beyond which they are susceptible to erosion. The designer should select the type of liner that best fits site conditions. Before grass is established, permissible velocity is determined by the choice of temporary liner. Permissible velocities for riprap linings are higher than for grass and are dependent upon on the stone size.

Recommended Manning's n values for natural channels are given in Table 4.9 and recommended Manning's n values for artificial channels are given in Table 4.10.

Table 4.9 - Recommended Manning's n Values for Natural Channels

Type of channel and description	Minimum	Normal	Maximum
Minor Streams (top width at flood stage < 100 ft)			
a. Streams on plain			
1. Clean, straight, full stage, no rifts or deep pools	0.025	0.03	0.033
2. Same as above, but more stones and weeds	0.03	0.035	0.04
3. Clean, winding, some pools and shoals	0.033	0.04	0.045
4. Same as above, but some weeds and stones	0.035	0.045	0.05
5. Same as above, lower stages, more ineffective slopes and sections	0.04	0.048	0.055
6. Same as 4, but more stones	0.045	0.05	0.06
7. Sluggish reaches, weedy deep pools	0.05	0.07	0.08
8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.1	0.15
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	0.03	0.04	0.05
2. Bottom: cobbles with large boulders	0.04	0.05	0.07
Flood Plains			
a. Pasture, no brush			
1. Short grass	0.025	0.03	0.035
2. High grass	0.03	0.035	0.05
b. Cultivated areas			
1. No crop	0.02	0.03	0.04
2. Mature row crop	0.025	0.035	0.045
3. Mature field crop	0.03	0.04	0.05
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.05	0.07
2. Light brush and trees, in winter	0.035	0.05	0.06
3. Light brush and trees, in summer	0.04	0.06	0.08
4. Medium to dense brush, in winter	0.045	0.07	0.11
5. Medium to dense brush, in summer	0.07	0.1	0.16
d. Trees			
1. Dense willows, summer, straight	0.11	0.15	0.2
2. Cleared land with tree stumps, no sprouts	0.03	0.04	0.05
3. Same as above, but with heavy growth of sprouts	0.05	0.06	0.08
4. Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.08	0.1	0.12
5. Same as above, but with flood stage reaching branches	0.1	0.12	0.16

Abridged from Chow, V.T., ed. 1959, Open-Channel Hydraulics

Table 4.10 - Recommended Manning's n Values for Artificial Channels

Rip rap	*n (depth of flow ≥ 2')*
Class B stone	0.037
Class 1 rip rap	0.040
Class 2 rip rap	0.045

Note: See Table 4.11 for temporary lining materials such as straw matting. If using values other than ones listed above or in Table 4.9, please provide documentation

Table 4.11 - Recommended Manning's n Values for Temporary Lining Materials

Lining Type	0.0' - 0.5'	0.5' - 2.0'	> 2'
Jute Net	0.28	0.022	0.019
Straw/Curled Wood Mat	0.066	0.035	0.028
Synthetic Mat	0.036	0.025	0.021

For maintenance and stability reasons, the maximum side-slope for open channels is 3:1. The channel protection required to prevent erosion is determined by computing the velocity in the channel at the design discharge and comparing that velocity with the permissible value for the type of channel lining used.

Culverts

(1) For culverts, the 25-year storm shall be used unless otherwise required by Town staff. Culverts shall be sized in accordance with the Energy Equation and applicable nomographs to carry the design flow and to provide a velocity of at least 2 feet per second during the 2-year storm. The minimum slope for culverts shall be 1% unless the existing stream channel is flatter. In no case should pipe slopes be less than 0.5%.

(2) Culvert design on Town maintained roads shall provide 1 foot of freeboard from the edge of road surface during the:

a. 10-year, 24-hour storm event for all driveways, alleys, local streets, and main streets.

b. 25-year, 24-hour storm event for all other streets.

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

(4) Stream crossings requiring greater than a 36-inch culvert will necessitate a back water study of the 100-year storm.

(5) Determining the hydraulic efficiency of a culvert requires calculation of three energy losses: inlet losses (resulting from the shape and alignment of the entrance to a culvert), outlet losses (resulting from the change in cross-sectional area at the outlet of a culvert),

and friction losses (resulting from resistance to flow within a culvert). Culvert design may require the calculation of the hydraulic grade line to ensure surcharge protection.

a. The **inlet control analysis** evaluates the capacity of a culvert at its entrance considering the depth of headwater, type of inlet, and the entrance shape. The headwater depth is the vertical distance from the culvert invert at the entrance to the headwater pool surface. The roughness, length and outlet conditions of the culvert are not factors in an inlet control analysis. Inlet control calculations shall be provided for all culverts and demonstrate a headwater over depth (HW/D) ratio less than or equal to 1.0 preferred, with an absolute maximum of 1.2.

b. The **outlet control analysis** evaluates the capacity of a culvert considering all hydraulic factors upstream from the outlet. These hydraulic factors include the culvert shape, length, slope, and roughness, and the depth of water at the culvert outlet. Friction losses are part of the outlet control analysis. The downstream hydraulic gradient at the outlet end of the culvert shall be the “known” water surface elevation (based on downstream backwater elevation) or the crown of the pipe, whichever is greater. Outlet control calculations shall be provided for all culverts and demonstrate a headwater over depth (HW/D) ratio less than or equal to 1.0 preferred, with an absolute maximum of 1.2.

(6) Culvert End Treatments are intended to provide protection against excessive scour at inlets and outlets. End treatments typically include flared end sections and/or headwalls.

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

Drainage Pipes

After the tentative locations of inlets, drain pipes, and outfalls with tailwaters have been determined and the inlets have been sized, the next logical step is the computation for the rate of discharge to be carried by each drain pipe and the determination of the size and gradient of pipe required to convey this discharge. This is done by proceeding in steps from upstream of a line to downstream to the point at which the line connects with other lines or the outfall, whichever is applicable. The discharge for a run is calculated, the drain pipe serving that discharge is sized, and the process is repeated for the next run downstream. It should be recognized that the rate of discharge to be carried by any particular section of drain pipe is not necessarily the sum of the inlet design discharge rates of all inlets above that section of pipe, but as a general rule is somewhat less than this total. It is useful to understand that the time of concentration is most influential and as the time of concentration grows larger, the proper rainfall intensity to be used in the design grows smaller.

For ordinary conditions, drain pipes should be sized on the assumption that they will flow full or practically full under the design discharge but will not be placed under pressure head. The Manning’s equation is recommended for capacity calculations.

The following criteria apply to storm drainage pipes under public streets, within public rights-of-way, and/or within public drainage easements.

(1) For enclosed pipe system sizing, the Hydraulic Grade Line (HGL) shall not exceed the crown of pipe elevation for the 10-year storm event and shall not exceed the top of structures (or gutter line elevation, as appropriate) for the 25-year storm event.

(2) Where the HGL cannot be fully contained within the pipe due to physical or engineering constraints, the Town may allow pipe meeting ASTM C443/AASHTO M198 (Joints for Concrete Pipe and Manholes using Rubber Gaskets) to be used for the affected line segments.

(3) All drainage pipes to be maintained by the Town shall be Class III or greater reinforced concrete pipe. The minimum inside pipe diameter shall be 15 inches. Pipe joints shall be sealed.

(4) Flared-end sections may be used with pipes ≤ 36 inches in diameter. The flared end section shall be installed with appropriate curtain wall. Flared end sections may not be installed on multiple pipe culverts. End walls shall be provided for single pipes with diameters > 36 inches and on multiple pipe culverts unless alternative end treatments are approved by the Town.

(5) The maximum pipe velocity shall not exceed 20 feet per second, or 10 feet per second in corrugated metal pipe.

(6) The maximum discharge velocity at a pipe outlet is 10 fps.

(7) Energy dissipaters shall be installed at all discharge points and shall be properly sized to ensure that stormwater is released at a non-erosive velocity. A fabric barrier shall be installed between dissipation pads and the natural ground.

(8) The minimum pipe slope shall be 0.5% and maximum acceptable slope shall be 10%. Storm drainage pipes shall be sized in accordance with the Manning Equation and applicable nomographs to carry the design flow and to provide a velocity of no less than 2 feet per second when the pipe is flowing half-full.

(9) The maximum pipe length without installation of a structure providing maintenance access is 400 feet (catch basin, curb inlet, junction box, etc.). Pipe shall be installed to provide a true line and grade between structures. Structures shall be installed at each deflection of line and/or grade.

(10) The minimum cover for drainage pipes is 2 feet unless otherwise approved by the Town Manager. Pipes shall maintain a minimum of 2 feet of cover from top of pipe to bottom of pavement structure within a roadway, or finished grade when not within a load bearing area.

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

(12) Sanitary sewer mains shall have a minimum vertical separation of 24 inches between storm pipes when the horizontal separation is 3 feet or less. Where sanitary and storm sewers cross with a vertical separation of less than 24 inches, the entire leg of sanitary sewer shall be made of standard ductile iron pipe with joints rated for water main service and the void space between the pipe crossing shall be backfilled with 3000-psi concrete or quick setting, minimum 500-psi, non-excavatable flowable fill that meets or exceeds NCDOT specifications.

The classifications all streams, creeks, and/or waterbodies within 100’ of sanitary sewers shall be documented and it shall also be documented that the sanitary sewer separation is in accordance with 15A NCAC 2T .0305 (f) and (g).

Sanitary sewers located adjacent to streams shall be located outside of the streambed and sufficiently removed therefrom to provide for future possible stream widening and to prevent pollution by siltation during construction.

(13) Prohibited Illicit Connections shall include, but are not limited to:

a. Any connection conveying discharges of sanitary sewerage, process wastewater, dumpster runoff, cooling or boiler water
b. Area (floor) drains serving interior covered spaces (such as parking decks or garages)
c. Sump pits serving related to hydraulic or mechanical equipment (elevators)

Outlet Protection

(1) The outlet protection should be designed in accordance with the North Carolina Erosion and Sedimentation Control Planning and Design Manual or other approved methods. The engineer should submit calculations with drawings for approval.

(2) Outlet Protection must be provided as necessary to dissipate energy and to create diffuse flow at the outlet ends of conveyance structures. Outlet protection measures include installation of rock-reinforced aprons, stilling basins, level spreaders, or other approved methods.

(3) Evaluation of flow conditions, scour potential, and channel erosion should be included in standard design analyses. The initial protection against channel erosion should be sufficient to minimize the impacts of a single storm event. Stilling basin and level spreader installations are preferred means of energy dissipation.

(4) The use of local rock is preferred in lieu of quarried riprap for the construction of energy dissipating rock aprons and stilling basins. This Design Manual provides the minimum dimensions for rock aprons and stilling basins at storm drainage outlets. However, existing conditions at the outlet and scour potential may dictate the installation of outlet protect measures in excess of the minimum requirements.

Subsurface Drainage

The installation of subsurface drainage measures may be required to protect against inundation of subgrade materials when landscaped and/or irrigated areas are constructed adjacent to streets or sidewalks.

Regulatory Floodways

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

Reserved Storm Drainage Easement

1) The standard utility easement width is thirty feet (30') wide. Easements for more than one utility typically are increased ten feet in width for each additional underground utility to provide for adequate separation between utility lines.

2) All engineered stormwater facilities intended for management of peak discharges, volume, or water quality treatment shall be located within easements entitled: "RESERVED STORM DRAINAGEWAY EASEMENT" and shall be indicated on the Stormwater Management Plan.

3) Unless specifically designated as being "Public", these easements and the facilities/functions they serve are considered by the Town to be private, and the Town assumes no responsibility for necessary inspection, operation, and/or maintenance duties. These easements shall be maintained by homeowner or property owner associations, or in the absence thereof, the individual property owner. Private drainage easements should be located in open space to the maximum extent practicable.

4) Encroachments into any drainage easement, except those expressly permitted, shall be prohibited.

5) When a yard swale or private pipe drains two or more upstream properties or conveys a 10-year storm event peak flow rate of 2 cfs or greater, a storm drainage easement of ≥ 20' shall be provided.

6) All drainage easements shall be drivable and constructed of a solid surface where they intersect a roadway.

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

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

4.5 STORMWATER CONTROL MEASURES

All design submittals shall be sealed by a professional engineer licensed in the State of North Carolina. Stormwater design summaries and checklists are included in Appendix A. While not required, the checklists are very helpful to the reviewer and may expedite the review.

Stormwater Control Measures Hyperlink

NCDEQ Stormwater Design Manual

4.6 ADJUSTMENTS OR WAIVERS

Information requirements may be adjusted or waived by the Town Manager for a particular development application upon written request of the applicant, provided that at least one of the following circumstances can be demonstrated:

1. Alternative measures for on-site and/or off-site management of stormwater have been proposed, and these measures are approved by the Town Manager and comply with local ordinance(s).

2. It is otherwise demonstrated that the proposed development will not produce any significant change to the existing pre-application hydrology.

4.7 STORMWATER MANAGEMENT REPORT REQUIREMENTS

Pursuant to the Town of Chapel Hill Land Use Management Ordinance Section 5.4, Stormwater Management, all applications for developments or subdivisions and any building (some single-family or two-family dwellings resulting in less than or equal to 20,000 square feet of land disturbance may not be subject to these requirements) within the Town of Chapel Hill Planning Jurisdiction must include a Stormwater Management Report. As authorized by the Chapel Hill Land Use Management Ordinance, affirmative exemption to all or part of the requirements of the Stormwater Management Report may be granted by the Town.

Stormwater Management Report requirements include:

a. Written narrative describing.

   1. Existing & proposed conditions
   2. Pertinent onsite and offsite drainage conditions
   3. Anticipated stormwater impacts
   4. Design criteria
   5. Discussion of structural and non-structural SCMs and strategies chosen to mitigate development impacts that will be part of the stormwater management plan
   6. Soils information (classification, infiltration rates, depths to groundwater and bedrock)

b. Summary tables of the peak discharge flow rates (1, 2, and 25-year storms) for pre-development; post-development without stormwater management; and post-development with stormwater management, for *each* sub-basin/POA *and* the project site as a whole.

Summary of Peak Discharge Flowrates, Q *(cfs)*

Point of Analysis (POA) / Basin ID:____

Design Storm	Pre-development	Post-development			
		w/out Mitigation	w/Mitigation	$\Delta_{(PRE)-(POST\ w/Mitigation)}$	
	(cfs)	*(cfs)*	*(cfs)*	*(cfs)*	*(%)*
1-yr, 24-hr					
2-yr, 24-hr					
25-yr, 24-hr					

Summary Runoff Volumes (*ft^3*)

Point of Analysis (POA) or Basin ID	2-Yr, 24-hr Storm			WQV *(P = 1"),* Post-dev (ft^3)	SCM Storage (ft^3)
	Pre-dev (ft^3)	Post-dev (ft^3)	$\Delta_{(PRE)-(POST)}$ (ft^3)		
(indicate each POA or Basin ID and add rows as necessary)					
Σ					

c. Summary table of the volume management results (WQV and 2-year storms) for pre-development; post-development without stormwater management; and post development with stormwater management, for all sub-basins/POAs and the project site as a whole.

d. Hydrology calculations, to include:

1. Pre-development and post-development drainage maps clearly labeled and showing delineated drainage sub-basins; connectivity of conveyance system and stormwater structures; and POAs. Flow paths in each sub-basin must be indicated (may be included in plan set). Drainage area maps must be to scale; scale shall be no smaller than 1-inch = 100-feet.

2. Summary table of land uses and areas (in square feet) within each drainage basin, curve numbers/runoff coefficients for each land use, Basin ID, and source of values used.

3. Time of concentration (T_c) calculations

4. Peak discharge calculations, with results documented in a summary table (See b. above).

5. Volume management calculations, with results documented in a summary table (See c. above).

e. Hydraulic calculations, to include:

1. Water quality volume calculations for providing 85% TSS removal for post-development stormwater runoff

2. BMP sizing calculations, including stage-storage-discharge information

3. Routings and hydrographs for each sub-basin point of analysis

4. Pipe sizing calculations, pipe schedule and Hydraulic/Energy Grade Line (HGL/EGL) study (for all storm drainage pipe systems; the study shall include profiles with labeled inverts, slopes, proposed finished grade and hydraulic grade line for 10-year, 24-hour and 25-yr, 24-hour storm events)

5. Channel sizing calculations

6. Outlet dissipater sizing calculations

HGL/EGL Study must include all portions of private storm sewer collection system(s) to the outlet structure(s) or connection(s) to public (ToCH or NCDOT) storm sewer infrastructure.

Final plans will need to detail the types and frequency of inspection and maintenance operations (major and minor), equipment necessary to perform maintenance activities, access to the stormwater control facility, disposal methods for uncontaminated and contaminated materials, and information regarding the facility owner(s) and party or parties responsible for facility operation and maintenance. The Town will require a maintenance plan and may require that a perpetual maintenance bond be posted.

f. Nutrient Loading Calculations – Completed output from Jordan/Falls Stormwater Load Accounting Tool printed on 11x17 paper.

g. Draft Inspections, Operations, and Maintenance Plan for each stormwater management structure.

STAFF NOTE: When responding to review comments, the applicant should provide a response to each comment and indicate where the changes have been made. Plan revisions should be highlighted graphically, e.g., clouds, boxes, etc. An example of the preferred layout of the Stormwater Submittal is outlined above.

Stormwater submittal requirements	Required for preliminary submittal	Required for final submittal
a. Written narrative describing:	x	x
1. Existing & proposed conditions	x	x
2. Pertinent onsite and offsite drainage conditions	x	x
3. Anticipated stormwater impacts	x	x
4. Design criteria	x	x
5. Discussion of structural and non-structural SCMs and strategies chosen to mitigate development impacts that will be part of the stormwater management plan.	x	x
6. Soils information (classification, infiltration rates, depths to groundwater and bedrock)	x	x
b. Summary tables of the peak discharge flow rates for the 1, 2, and 25-year, 24-hour storms for *each* sub-basin/POA *and* the project site as a whole.	x	x
1. Pre-development	x	x
2. Post-development without stormwater management	x	x
3. Post-development with stormwater management		x
4. Change in predevelopment to post-development with stormwater management		x
c. Summary table of runoff volumes (WQV and 2-year storms) for all sub-basins/POA and the project site as a whole.	x	x
1. 2-yr, 24-hr, Predevelopment	x	x
2. 2-yr, 24-hr, Post-development	x	x
3. 2-yr, 24-hr, change in predevelopment to post-development	x	x
4. WQV	x	x
5. SCM Storage		x
d. Hydrology calculations, to include:	x	x
1. Predevelopment and post-development drainage maps to scale; scale shall be no smaller than 1-inch = 100-feet.	x	x
A. Clearly labeled with delineated drainage sub-basins	x	x
B. Showing Points of analysis (POAs)	x	x
C. Showing connectivity of conveyance system and stormwater structures		x
D. Showing flow paths in each sub-basin (may be included in plan set)		x
2. Summary table of land uses and areas (in square feet) within each drainage basin, curve numbers/runoff coefficients for each land use, Basin ID, and source of values used.		x
3. Time of concentration (T_c) calculations		x
4. Peak discharge calculations, with results documented in a summary table (See b. above).		x
5. Volume management calculations, with results documented in a summary table (See c. above).		x
e. Hydraulic calculations, to include:	x	x
1. Water quality volume calculations for providing 85% TSS removal for post-development stormwater runoff	x	x
2. BMP sizing calculations	x	x
A. Including surface area / sizing requirements	x	x
B. Including stage-storage-discharge information		x
3. Routings and hydrographs for each sub-basin point of analysis		x
4. Pipe sizing calculations, pipe schedule and Hydraulic/Energy Grade Line (HGL/EGL) study (for all storm drainage pipe systems; the study shall include profiles with labeled inverts, slopes, proposed finished grade and hydraulic grade line for 10-year, 24-hour and 25-yr, 24-hour storm events)		x
5. Channel sizing calculations		x
6. Outlet dissipator sizing calculations		x
f. Nutrient Loading Calculations - Completed Jordan Lake Stormwater Load Accounting Tool, if required, printed on 11x17 paper.		x
g. Draft Inspections, Operations, and Maintenance Plan for each stormwater management structure.		x

4.8 SINGLE-FAMILY DESIGN GUIDELINES

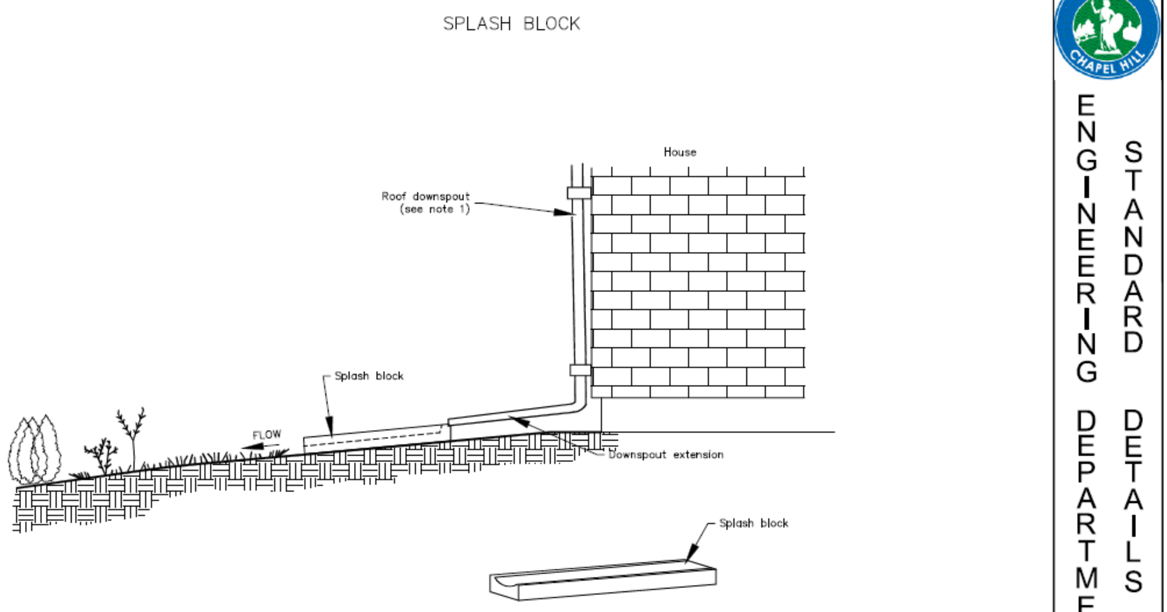
A Professional Engineer's Certification and Stormwater Management Plan are required for all Zoning Compliance Permit/Building Permit Applications for single or two-family development involving more than 20,000 square feet of land disturbance. The Stormwater Management Plan shall indicate the Stormwater control measures (SCMs) necessary to manage peak discharge rate, to provide 85% total suspended solids (TSS) removal and, if applicable, to provide volume management.

All design submittals shall be sealed by a professional engineer licensed in the State of North Carolina. The Stormwater Management Plan shall include all applicable stormwater impact calculations. Erosion control measures and a Stormwater Operations and Maintenance Plan are required for all development disturbing more than 20,000 square feet of land area. Prior to issuance of a Certificate of Occupancy (CO), a P.E. Certification must be submitted certifying that the stormwater management measures were installed as shown on the approved Stormwater Management Plan, and the agreed upon stormwater easement(s) and covenant(s) must be recorded with the appropriate County Register of Deeds.

Consider the site conditions when planning the project:

1) Maintain natural drainage patterns as much as possible
2) Minimize the amount of land disturbance
3) Minimize the impervious area footprint
4) Runoff must be discharged in a non-erosive and diffused manner
5) Energy dissipaters are required at all outlets
6) No drainage outlets are permitted in setbacks or riparian buffers

CONCRETE SPLASH BLOCK DETAIL



GENERAL NOTES:

1. No more than 700 sq. ft. of roof area may be drained to a single splash block.
2. Splash block shall drain to a minimum of 50 ft. of well established vegetation. If less than 50 ft. of well established vegetation is present then the splash block must discharge to Rock Level Spreader (see detail SD–15).

NOTE: DRAWING NOT TO SCALE

TITLE:	REVISIONS		DET. NO.
SPLASH BLOCK			SD-14

4.9 APPLICABLE REGULATIONS

- Stormwater Management - §5.4 Land Use Management Ordinance. Requires projects to address water quality, volume and rate.
- Steep Slopes - §5.3.2 Land Use Management Ordinance. Steep slope restrictions and requirements.
- Jordan Riparian Buffers - §5.18 Land Use Management Ordinance. Regulates activities in and adjacent to the Jordan riparian buffer, which is the first 50 feet measured landward from the top of bank, each side.
- Jordan Stormwater Management - §5.19 Land Use Management Ordinance. Adds nutrient (nitrogen and phosphorus) reductions in addition to the Town's stormwater management requirements.
- Flood Damage Prevention Ordinance - Chapter 5, Article IV Town Code of Ordinances. Any modifications to the floodway or floodplain will require modeling.
- Soil Erosion and Sediment Control – Chapter 5, Article V Town Code of Ordinances. Requires erosion and sediment control permit for land disturbance of 20,000 sq. ft. or more, from Orange County Erosion Control. The Town requires a bond.
- Resource Conservation District - §3.6.3 Land Use Management Ordinance. Town's stream buffer regulation.

  Watershed Protection District - §3.6.4 Land Use Management Ordinance. Limits impervious area to 50% and 70% of net land area for single-family and non-single-family residential development, respectively.

Chapter 5
Utilities

5.1 GENERAL

Utility Providers

The public water and sanitary sewer systems within the Town of Chapel Hill and its Extraterritorial Jurisdictional (ETJ) are owned and operated by Orange Water & Sewer Authority (OWASA). Before beginning utility planning or design work the engineer should consult with the Town to determine ownership of the utilities in the project area. For utilities owned and operated by others within the Town and its ETJ, consult with that particular owner's' engineering department for plan requirements or submittal procedures.

Information on water and sewer design standards and permitting for OWASA owned utilities can be found in the OWASA's Standard Specifications, latest edition. The Design Engineer should refer to OWASA's Technical Specifications and Detail Drawings, Water Line and Sanitary Sewer Line Construction, latest edition, for all material specifications and detail drawings.

Location of Underground Utilities

Before commencing any excavations in any highways, streets, public spaces, or in an easement, the State of North Carolina Underground Damage Prevention Act Article 8, § 87-102 requires notification of each utility owner having underground utilities located in the proposed area to be excavated, either orally or in writing, not less than two nor more than ten working days prior to starting, of the intent to excavate. If planning on digging, excavating, demolishing, or moving the earth in any way that could damage underground utility facilities, call the North Carolina One-Call Center toll free number (811) 72 hours before work commences.

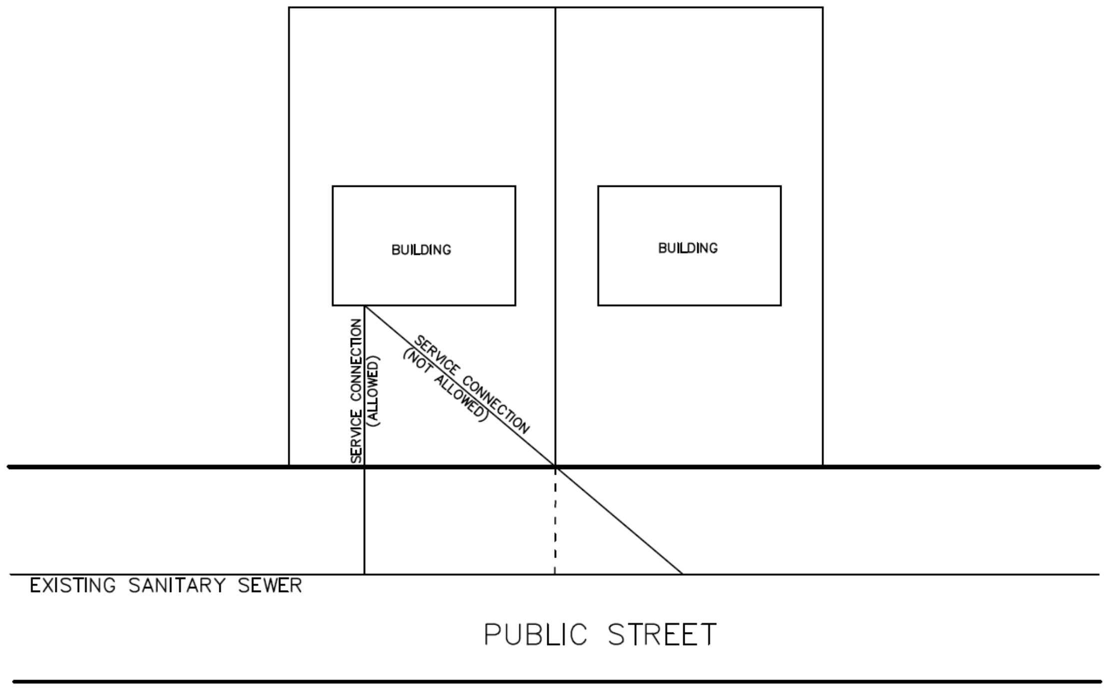
Interrelation of Utility Lines

The installation and location of any utility line shall be integrated with that of all other utility lines in the vicinity so as to avoid cross-connections, minimize trenching and tunneling, and keep incompatible systems separate. Notwithstanding, sufficient preparation shall be provided as soon as possible to minimize digging that would result in customer service interruption and to minimize adverse operating environments for other utilities.

Private Water Lines and Sewer Lines in the Public Right-Of-Way

Private water lines and sewer lines are not permitted to extend into the right-of-way beyond the intersection of the property corner or within the public right-of-way across the street frontage of another parcel. Service lines should not cross adjacent private properties. Perpendicular crossings of public right-of-way are allowed.

Figure 5.1 Private Water Lines/Sewer Lines in the ROW



Water Main and Service Abandonment

Contractors abandoning water services shall remove the entire service stub. A plan shall be provided to the Town identifying the location of the abandoned line. All remaining portions of the service stub shall be removed from the main to the right of way line and shall be disposed of properly. Water main abandonment within the public street must be performed in accordance with a plan approved by the Public Works Department and OWASA. Service and main abandonment requires an inspection by the Public Works Department. The abandoned pipe shall be filled with flowable fill and shall be abandoned as shown in OWASA Standard Detail 512.05, or as described in OWASA's standards & specifications and according the North Carolina Department of Transportation standards

Underground Utilities

Where underground utility lines are to be provided beneath street roadways, sidewalks, or other paved access ways, all such lines shall be consolidated, where practical, in a contiguous area so as to optimize excavation for installation consistent with good operations and maintenance. Where underground utility lines are to be located within a street right-of-way, sewer lateral lines shall be provided from the trunk lines to the right-of-way line for all lots and/or development sites along the street, and shall be installed concurrent with the installation of the trunk line to minimize cutting and repairing of street sub-surfaces, base courses and paving. Sanitary sewer laterals shall have cleanouts at the edge of the right-of-way. Lateral lines shall be installed as close to a 90-degree angle to the trunk line as possible and should not cross into or along the street frontage of abutting lots.

The minimum required horizontal separation between water, sanitary sewer and stormwater drainage pipes installed in a common easement is ten feet

Record Drawings

Prior to a Certificate of Occupancy, Record Drawings shall be provided for all development for which a Zoning Compliance Permit or Engineering Construction Permit was required. In addition to providing the depth of the installation and horizontal location the Record Drawings shall call out the type of utility, size, and materials used for the installation.

Trench Backfill

Backfilling open cuts: The contractor shall backfill any trench made with approved soil that is free of organic material and does not contain more than five (5) per cent clay content (number 200 sieve). Backfill material at a moisture content range within two (2) per cent of optimum, per ASTM D-648.

Compaction tests shall be provided for all utility main line, and service lateral installations and removals, unless affirmatively exempted by the Town's Engineering Inspector. All backfill shall be compacted in six-inch lifts measured from the pipe foundation. Backfill for roadway shall be compacted to at least 98% of maximum soil density per ASTM D698 (Standard Proctor). Laboratory determination of maximum soil density will follow the procedure of AASHTO T99-86. Field determination of the density of the soil in place shall follow the procedure of AASHTO T191-86 or T204-86. The result of any one test may be a minimum of 95% of maximum density, but the average of any three tests in an area shall be 98% of maximum density. All tests shall be conducted at the direction of the Town Inspector, and the cost of such tests will be borne by the contractor.

Where trench compaction using standard procedures is impractical, or if time constraints so dictate, the Town will require the use of flow able fill material.

Pavement Removal and Replacement

All pavements to be removed shall be cut along straight lines with the appropriate saw cut machine. The removal and replacement of the pavement shall conform to the information shown in the pavement repair information provided in this manual. (See pavement repair requirements in Chapter 10).

- All cuts of Town streets must be patched the same day with a temporary or permanent patch. (Steel plating is allowed with special permission of the Public Works Department.) After work has been completed, all temporary patches shall be replaced with permanent ones. All work from patching shall be cleaned up at the same time as patching.
- The Town shall require the contractor to perform density tests as needed to determine subgrade compaction.
- Pavement cuts shall be confined to a maximum trench width as shown in the Town Standard Details.

- Asphalt compaction shall be done with a gasoline or diesel powered smooth drum roller.

Surface Appurtenances
Surface appurtenances such as pump stations, backflow preventers, transformer boxes, pedestal-mounted thermal boxes, and meter cabinets shall be located so as to minimize safety hazards, visual impact, and noise effects.

5.2 SEWAGE COLLECTION SYSTEM

Within the Urban Services Boundary a system of sanitary sewers, together with all necessary pumping station and appurtenances, shall be provided to serve all parcels of the subdivision or principal building of the development. The system shall be designed to accommodate all reasonably anticipated future construction and occupancies. The collection system shall convey the sewage in sewers of adequate capacity to an approved treatment facility. For development outside of the Urban Services Boundary, approval of the lot by the County Health Department shall be required.

Flood Policy
In flood prone areas, the manholes must be watertight and vented to three feet above the 100-year flood elevation Pump stations must be approved by OWASA and constructed above the 100-year flood elevation as determined by the current FEMA Flood Insurance Rate Map (FIRM).

Provisions for Future Service Areas
Where adjacent property is in the same drainage basin as the property being developed, lines shall be designed to accommodate development of other properties in the same drainage basin. Easements or other right-of-ways should be consistent with the potential needs for future extensions as well as the project under consideration.

Design and Construction Standards and Materials
The sewage collection system shall conform to all requirements and minimum standards of OWASA and of the applicable County and State regulatory agencies, unless more stringent standards are provided herein. Ductile iron pipe must be used for taps to the public sewer and must extend to the property line. Clean-outs must be located at the right-of-way line.

5.3 WATER DISTRIBUTION SYSTEM

A water distribution system, providing potable water from an approved treatment facility, shall be provided to serve all parcels of the subdivision or principal buildings of the development. The pipes shall be sized to provide fire protection and an adequate supply of domestic water for all reasonably anticipated construction and occupancies.

Provisions for Future Service Areas
Developers may be required to install additional linear footage of water mains and/or of larger size to provide for water service to property outside the project under consideration. Easements and rights of ways should be provided for lines installed by the developer and provisions shall be available for extensions to other adjacent properties.

Design and Construction Standards

The water distribution system shall conform to all requirements and minimum standards of OWASA and of the applicable State and County regulatory agencies, unless more stringent standards are established herein.

All pipe shall be Ductile Iron. If a developer deviates from this type of pipe it must be approved by the Town Manager after consultation with OWASA.

Fire Prevention Provisions

Fire Flow

The piping for fire protection shall provide a minimum residual pressure of at least 20 psi when the following gallons per minute of fire flow is withdrawn from any hydrant. The fire flow calculation area shall be the total floor area of all floor levels within the exterior walls, and under the horizontal projections of the roof of a building, except as modified by the North Carolina Fire Code. The Fire Chief and Fire Marshal are authorized to increase or decrease the fire flow requirements where conditions indicate.

- One and Two Family Dwellings (less than 3,600 SF) = 1000 gpm for one hour. For dwellings greater than 3,600 SF shall not be less than that specified in Table 5.1 on the following page. A reduction in required fire flow of 50 percent may be allowed by the Fire Marshal, if the building is equipped with an approved automatic sprinkler system.

- For buildings other than one and two family dwellings: The minimum fire flow and flow duration shall be as specified in Table 5.1. A reduction in required fire flow of up to 75 percent, as approved, may be allowed by the Fire Marshal when the building is equipped with an approved automatic sprinkler system. For additional information, consult the North Carolina Fire Code, latest edition.

Prior to issuance of a Zoning Compliance Permit, a fire flow report shall be submitted to the Town Manager for approval. The report must call out the gallons per minute that would be available at the applicable hydrant(s), state if the available fire flow will comply with the Town's standards and be sealed by an engineer registered in North Carolina. A typical report would include an OWASA flow test that was conducted less than a year prior to submission of the report with supporting calculations.

If the required flows cannot be obtained from the existing OWASA systems, it is the developer's responsibility to make improvements to the system, with OWASA approval, as necessary to comply with Town fire flow requirements. If improvements to the OWASA system are not practical additional fire protection practices may be used.

Table 5.1 - Minimum Required Fire-Flow and Flow Duration for Buildings

FIRE-FLOW CALCULATION AREA (square feet)					Fire-flow (gallons per minute)[b]	Flow duration (hours)
Type IA and IB[a]	Type IIA and IIIA[a]	Type IV and V-A[a]	Type IIB and IIIB[a]	Type V-B[a]		
0-22,700	0-12,700	0-8,200	0-5,900	0-3,600	1,500	2
22,701-30,200	12,701-17,000	8,201-10,900	5,901-7,900	3,601-4,800	1,750	
30,201-38,700	17,001-21,800	10,901-12,900	7,901-9,800	4,801-6,200	2,000	
38,701-48,300	21,801-24,200	12,901-17,400	9,801-12,600	6,201-7,700	2,250	
48,301-59,000	24,201-33,200	17,401-21,300	12,601-15,400	7,701-9,400	2,500	
59,001-70,900	33,201-39,700	21,301-25,500	15,401-18,400	9,401-11,300	2,750	
70,901-83,700	39,701-47,100	25,501-30,100	18,401-21,800	11,301-13,400	3,000	3
83,701-97,700	47,101-54,900	30,101-35,200	21,801-25,900	13,401-15,600	3,250	
97,701-112,700	54,901-63,400	35,201-40,600	25,901-29,300	15,601-18,000	3,500	
112,701-128,700	63,401-72,400	40,601-46,400	29,301-33,500	18,001-20,600	3,750	
128,701-145,900	72,401-82,100	46,401-52,500	33,501-37,900	20,601-23,300	4,000	4
145,901-164,200	82,101-92,400	52,501-59,100	37,901-42,700	23,301-26,300	4,250	
164,201-183,400	92,401-103,100	59,101-66,000	42,701-47,700	26,301-29,300	4,500	
183,401-203,700	103,101-114,600	66,001-73,300	47,701-53,000	29,301-32,600	4,750	
203,701-225,200	114,601-126,700	73,301-81,100	53,001-58,600	32,601-36,000	5,000	
225,201-247,700	126,701-139,400	81,101-89,200	58,601-65,400	36,001-39,600	5,250	
247,701-271,200	139,401-152,600	89,201-97,700	65,401-70,600	39,601-43,400	5,500	
271,201-295,900	152,601-166,500	97,701-106,500	70,601-77,000	43,401-47,400	5,750	
295,901-Greater	166,501-Greater	106,501-115,800	77,001-83,700	47,401-51,500	6,000	
-	-	115,801-125,500	83,701-90,600	51,501-55,700	6,250	
-	-	125,501-135,500	90,601-97,900	55,701-60,200	6,500	
-	-	135,501-145,800	97,901-106,800	60,201-64,800	6,750	
-	-	145,801-156,700	106,801-113,200	64,801-69,600	7,000	
-	-	156,701-167,900	113,201-121,300	69,601-74,600	7,250	
-	-	167,901-179,400	121,301-129,600	74,601-79,800	7,500	

-	-	179,401-191,400	129,601-138,300	79,801-85,100	7,750	
-	-	191,401-Greater	138,301-Greater	85,101-Greater	8,000	

Taken from Table B105.1 Minimum Required Fire-Flow and Flow Duration for Buildings, NC Appendix B, 2012 NC Fire Code

For SI: 1 foot=0.0929 m^2, 1 gallon per minute = 3.785 L/m, 1 pound per square inch = 6.895kPa.
a. Types of construction are based on the International Building Code.
b. Measured at 20 psi residual pressure.

Fire Hydrants

Fire hydrants shall be placed on lines eight (8") inches or larger in diameter unless approved otherwise by the Town Manager and OWASA. Hydrants shall also be spaced so that the farthest portion of all principal buildings, divisions thereof or dwelling units therein, and all building areas of site plans and parcels are within 400 feet (as a fire hose would normally be deployed) of a hydrant; and if applicable on the same side of an arterial street. This distance may be increased from 400 feet to 500 feet for sprinkled structures.

Fire hydrants shall be located on loop main line systems with two (2) sources of flow when reasonably possible as determined by the Town Manager after consultation with OWASA.

Subject to approval by the Fire Marshal a fire hydrant may be served from a 6-inch water main if the fire flow requirements are met, the 6-inch line does not exceed 400 feet in length, and if this section of the main waterline is not part of a continuous looped waterline system. Typically, a 6-inch waterline is only allowed to serve a cul-de-sac, or dead-end street.

Fire hydrants shall be located such that all points on streets and access roads adjacent to a building are within the distances listed. Existing fire hydrants on public streets are allowed to be considered as available. Existing fire hydrants on adjacent properties shall not be considered as available unless fire apparatus access roads extend between properties and easements are established to prevent obstruction of such roads. If protection of fire hydrants by bollards are needed they shall be installed subject to review by the Fire Marshal and OWASA.

Location of Valves

Valves shall be installed as required by OWASA.

Fire Department Connections

If protection of fire department connections by guard posts or bollards are needed they shall be installed, subject to review by the Fire Marshal and OWASA. Fire department connections must be located within 100 feet of a fire hydrant.

5.4 AUTOMATIC SPRINKLER SYSTEMS

Non-Residential - An automatic fire sprinkler-system meeting the requirements of National Fire Protection Association (NFPA) Standard 13 is required to be installed in non-residential construction, as follows. In new non-residential structures if:

- The building has more than 6,000 square feet of floor area, or
- 20 percent or more of the total floor area is more than 200 feet of travel distance from the nearest access point for a fire truck, or
- The building exceeds two stories or 24 feet in height from the height of average grade of the lot to the windows on the topmost occupied floor.

In addition, all fire department connections shall be located on the fire access side of each building, and activation of the sprinkler system shall activate both a local building alarm and an alarm at a twenty-four (24) hour certified and licensed alarm monitoring service.

Upon the occupancy of any new, renovated or expanded structure subject to this Section, no person shall shut off or disable such automatic fire sprinkler system and no owner or resident of such building shall fail to prevent the shutting off or disabling of such a system. Provided, however, that a sprinkler system may be shut off in order to perform maintenance work on the system during the time that qualified maintenance personnel are on the premises performing necessary maintenance work. Such maintenance work shall only be conducted after notice to and approval by the Town Fire Department.

Multi-Family

An automatic fire sprinkler system meeting the requirements of NFPA Standard 13 or 13R is required to be installed in new multi-family construction, renovations and additions, as follows. In all new multi-family residential structures of three or more attached housing units if:

- The building has more than 6,000 square feet of floor area, or
- 20 percent or more of the total floor area is more than 200 feet of travel distance from the nearest access point for a fire truck, or
- The building exceeds two stories of 24 feet in height from the average grade of the lot to the windows on the topmost occupied floor.

Activation of the sprinkler system shall activate both a local building alarm and an alarm at a twenty-four (24) hour certified and licensed alarm monitoring service.
Upon the occupancy of any new, renovated or expanded structure subject to this Section, no person shall shut off or disable such automatic fire sprinkler system and no owner or resident of such building shall fail to prevent the shutting off or disabling of such a system. Provided, however, that a sprinkler system may be shut off in order to perform maintenance work on the system during the time that qualified maintenance personnel are on the premises performing necessary maintenance work. Such maintenance work shall only be conducted after notice to and approval by the Town Fire Department.

Fraternity and Sorority Houses

An automatic fire sprinkler system meeting the requirements of NFPA Standard #13 or #13R is required to be installed in each fraternity and sorority house in accord with the compliance deadlines in the Town's Land Use Management Ordinance.

In addition, all fire department connections shall be located on the street side of each building, and activation of the sprinkler system shall activate both a local building alarm and an alarm at a twenty-four (24) hour certified and licensed alarm monitoring service.

Key Boxes

Key boxes shall be required on any building that has a fire alarm system, a fire sprinkler system, an elevator, or special locking arrangements. The key box shall be of an approved type as required from the Chapel Hill Fire Department. The size of the key box will be determined by the number of keys necessary to mitigate any emergency situation based on the building and its occupancy. An approved lock shall be installed on gates or similar barriers when required by the fire code official. Keys shall be changed out immediately if the locks are changed or rekeyed.

5.5 EASEMENTS

Public utilities are installed in either dedicated easements or public right-of-ways. The standard utility easement width is thirty feet wide. Easements for more than one utility typically are increased ten feet in width for each additional underground utility to provide for adequate separation between utility lines.

- The contractor or utility company should make a reasonable effort to avoid damage to landscaping and vegetation within and/or adjacent to easements. The Town will not be liable for plants, trees, and other vegetation damaged as a result of work associated with use of utility easements.
- When utilities are located in the public right-of-way it is desirable for the utilities to be located at the outer edge of the right-of-way. Utility poles should be located as near the right-of-way lines as practical. Utilities crossing under streets should be bored and jacked when practical.
- Utilities crossing under NCDOT streets are subject to the NCDOT's policy for utility installations.

Chapter 6
Landscaping and Tree Protection

6.1 DESIGN STANDARDS

Buffer Requirements

The following chart indicates the minimum width and planting requirements for each buffer type established in Section 5.6 of the Land Use Management Ordinance. The arrangement of plants within each buffer should be integral to the design concept of the project as a whole, as well as responsive to the landscapes of adjacent properties. The room required for plants to develop their natural form, especially large trees, should also be considered when determining plant spacing. Allowing greater than minimum buffer widths can therefore provide more design flexibility. The buffer locations shown in the chart refer to whether the buffer area is adjacent to a street (external) or adjacent to some other property line (internal). When developing external buffers, large trees may be planted within the public right-of-way if they are consistent with adjacent street tree plantings and are acceptable to the Town and the North Carolina Department of Transportation Landscape Design and Development Division, if applicable.

Table 6.1 - Plants per 100 Linear Feet

Buffer Type	Minimum Width	Location	Large Trees	Small Trees	Shrubs
"A"	15	External	2	4	6
		Internal	2	4	6
"B"	15	External	6	8	15
	10	Internal	4	7	12
"C"	20	External	5	10	36
		Internal	4	8	30
"D"	30	External	6	12	40
		Internal	5	10	30
"E"	100	External	10	15	70

Where the buffer width has been allowed to be reduced the landscape architect should consider the crowding of the proposed plants. The number of plants per liner feet can be reduced by increasing the caliper of the proposed tree size so the total caliper of all proposed trees remains the same. For example two minimum 2 inch caliper large trees may be replaced with one 4 inch caliper large tree. The landscape plan should show these calculations.

Examples of appropriate varieties of large and small trees and shrubs can be found in the Plant Selection Standards. When selecting shrub species, a minimum of 50% of the total number of required shrubs should be evergreen.

When it is acceptable to the Town, existing vegetation can be used to satisfy some or all of the required buffer plantings. In these cases, the existing vegetation shall be in good health and be protected during the development process. In most locations where existing vegetation is retained, supplemental plantings of evergreen shrubs along buffer edges will still be needed in order to meet the planting requirements noted above.

The location of existing or proposed utility easements should be taken into account when determining the location of proposed buffers. Consistent with Section 5.6.3 of the Land Use Management Ordinance, required buffers cannot overlap utility easements other than in locations where the easements cross these buffers. In these locations and where easements exist which may conflict with other landscaping standards, applicants should contact the affected utility provider to determine what types of plantings, typically limited to shrubs and small trees, are permitted within the easement areas.

When it is acceptable to the Town, existing vegetation can be used to satisfy some or all of the required plantings. In these cases, the existing vegetation should be in good health and be protected during the development process.

Aesthetics/Visual Quality

Objectives and functions of a buffer should include the following.

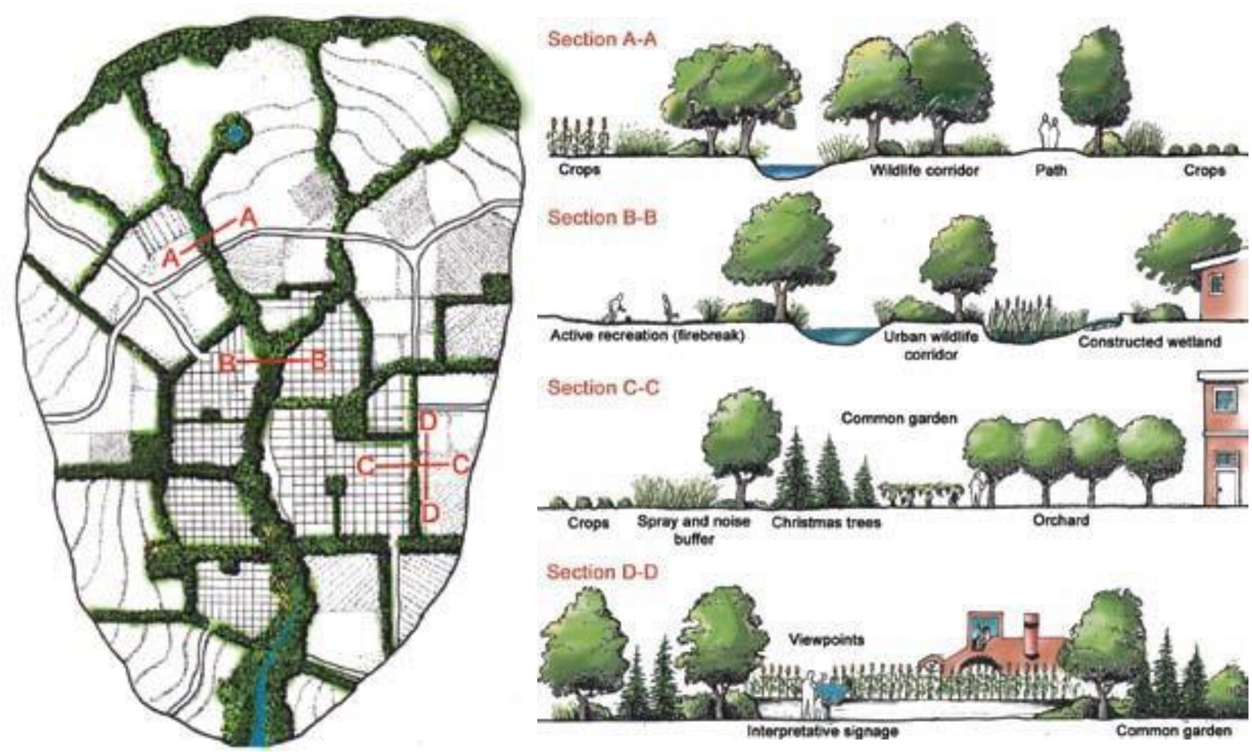
- Enhance visual interest
- Screen undesirable views
- Screen undesirable noise
- Filter air pollutants and odors
- Separate human activities

Table 6.2 - Design Guidelines for Aesthetics and Visual Quality

	Enhance visual interest	Screen undesirable views	Screen undesirable noise	Filter air pollutants and odors	Separate human activities
Rural/Urban land use buffer	✓	✓	✓	✓	✓
Windbreaks for odor control				✓	✓
Air quality buffers				✓	✓
Buffers for noise control			✓		✓
Developing and ecological aesthetic	✓				✓
Attractive roadside corridors	✓	✓	✓	✓	✓
Buffers for visual screening		✓			✓

Chart from Conservation Buffers, Design Guidelines for Buffers, Corridors, and Greenways, United States Department of Agriculture, Forest Service Southern Research Station, General Technical Report SRS-109, September 2008, Page 89.

Figure 6.1 is a conceptual plan and sections illustrating several types of conservation buffers in a watershed. Each buffer accomplishes different sets of functions and objectives.



Diagrams from: *Conservation Buffers, Design Guidelines for Buffers, Corridors, and Greenways*, *United States Department of Agriculture, Forest Service Southern Research Station, General Technical Report SRS-109, September 2008, Page 14*

Tree Canopy Coverage Requirements

General

Tree canopy coverage requirements found in Section 5.7 of the LUMO apply to projects requiring Town Council approval - Tree canopy coverage of 30 or 40 percent is required depending on the land use proposed. Table 3.1 below shows the minimum tree canopy coverage. Compliance with canopy requirements can be by:

- Protection of existing tree canopy;
- Replacement of tree canopy; and
- Payment into the Town's Tree Mitigation Fund ($500 per deficit tree**).**

Table 6.3 - Minimum Tree Canopy Coverage Standards

Land Use	Minimum Canopy Coverage
Multi-Family Residential	30%
Commercial (Use Group C and: Business, Office; Clinic; Funeral Home, and Hotel/Motel)	30%
Institutional (Use Group B)	40%
Mixed Use, Other	40%

Tree Canopy Measurement

The following steps can be followed to determine tree canopy measurement. For an example lot of 90,200 square feet in size as shown in figure 6.2 below.

Figure 6.2 – Tree Canopy Measurement Example

TREE CANOPY MEASUREMENT EXAMPLE

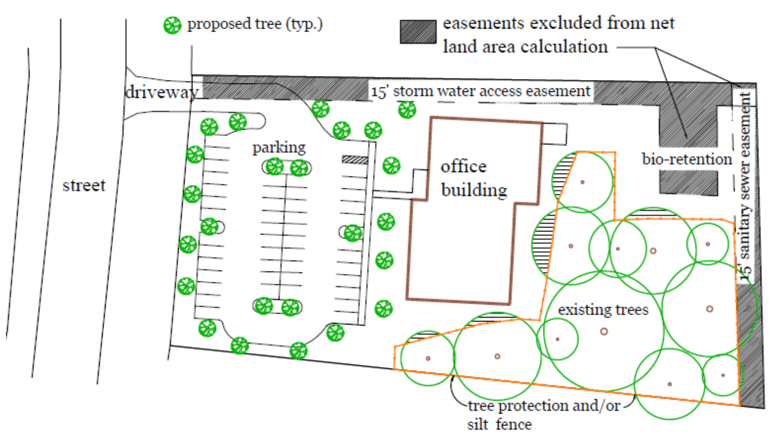
Gross Lot Size 90,200 sq.ft.

Net Lot Size 78,060 sq.ft., not including active cleared easements

Minimum tree canopy coverage for
Office-Institutional use = 40% (31,224 square feet)

Existing tree canopy protected = 24.3% (19,000 square feet)
including drip zone overlapping protective fencing

Tree canopy deficit = 12,224 square feet
Replacement trees required = 1 tree per 500 square feet of canopy deficit = 24 trees



Step One: Determine net lot size not including

- cleared utility and stormwater easements
- road rights-of-way and access easements
- cleared active recreation areas or
- water bodies

Net lot area = 78,060 square feet

Step Two: Calculate required canopy coverage as per Table 6.3 above

Net lot area times minimum canopy coverage for Office-Institutional Use

78,060 square feet X 40% = 31,224 square feet minimum

Step Three: Measure area of existing canopy to be protected

- Include all wooded areas protected by tree protection fence and/or silt fence and the drip zones of protected trees extending beyond these fences. For purposes of determining tree canopy the critical root zones of surveyed trees can be used to establish drip zone limits.
- Area of Existing Canopy Protected = 19,000 square feet (24.3%)

Step Four: Determine canopy deficit

Canopy Coverage Required [Step 2]	(40%)	31,224 square feet
Minus Existing Canopy Protected [Step 3]	(24.3%)	-19,000 square feet
Canopy Deficit	(15.7%)	12,224 square feet

Step Five: Calculate replacement trees

- 1 tree/500 square feet X 12,224 square feet = 24 replacement trees
- Count all trees to be planted:
  - In required land use buffers;
  - Required for parking lot shading;
  - Other trees not in buffers/parking areas planted at least 20' apart

Screening

Screening Standards

All parking lots shall be screened from public rights-of-way and adjacent properties zoned residential. The minimum height of the screening should be 3' above the existing grade of the parking lot edge for right-of-way screening and 6' above the existing grade for residential screening. These minimum heights should be reached within two (2) years of planting when vegetation is included to meet the screening standards. There should be no gaps in the screen greater than 6' wide.

Screening Materials

Fences or walls used for screening should be built of materials compatible with the principal building or existing adjacent fences or walls. A minimum of 25% of the surface area of all fences and walls should be screened by plant materials within two (2 years. Whether plantings alone or a combination of plantings and fences or walls are used for screening, the screen should be of a density to occupy 75% of a vertical plane of the required height for the peripheral length of the parking lot.

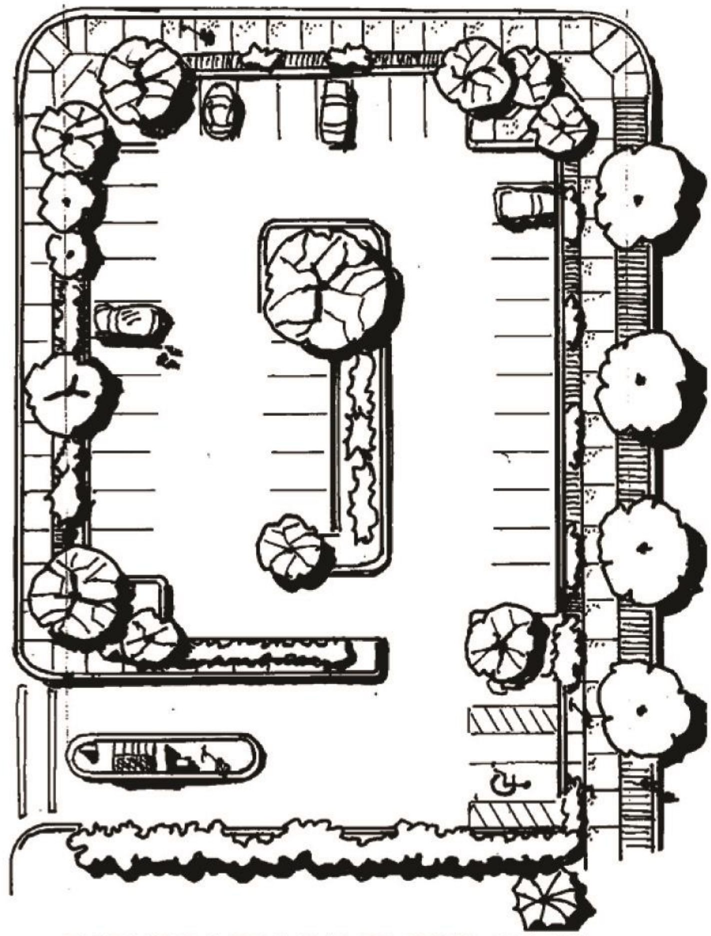
Plant materials used for screening in lieu of fences or walls shall be evergreen and have a minimum height of 2' when planted for 3’ tall screening, and 3’ when planted for 6’ tall screening.

Earth berms used for screening should have a minimum crown width of 2', maximum slopes of 3:1, and be covered with approved vegetation to provide a screen of the required height.

Parking Lot Shading Standards

One large tree per 2,000 SF of paved surface planted within 10' of the parking lot edge will satisfy this requirement if the plants are spaced appropriately. Typically, no parking space should be farther than 50’ from the trunk of a large tree, or farther than 75’ from 2 large trees.

Figure 6.3 – Parking Lot Landscape Detail



PARKING LOT LANDSCAPING DETAIL

Landscaped Island and Median Requirements

Landscaped islands in parking lots, and medians separating lanes of traffic on public streets and on internal drives, should be a minimum of 5' in width measured from the back of curb

If large trees are to be planted in landscape islands or medians, these islands or medians should be a minimum of 8' in width measured from the back of curb, and include a minimum of 150 SF of soil surface area per large tree.

Loading Area Requirements

All loading areas shall be screened from public rights-of-way and all adjacent properties. All standards applicable to screening parking lots are required of loading area screening, except the screening height shall be a minimum of 6' above existing grade for both right-of-way and residential screening.

Utility Service Area Requirements
All utility service areas should be screened from public rights-of-way and all adjacent properties. To avoid conflicts with utility services, applicants should review proposed plantings with affected utility providers prior to including such plantings on proposed planting plans.
All standards applicable to screening parking lots are required of utility service areas, and the screening height should be equal to or greater than the structure to be screened.

Screening should be located to provide adequate access and workspace for the utility structure and the installation of plants with thorns or pointed leaves should be avoided adjacent to the service area.

Tree Placement Requirements
When designing projects in the downtown area, developers should refer to the Town's Downtown Streetscape Master Plan for information about planter design and planting standards along downtown streets. For additional information developers should contact the Town's Public Works Department. In all areas it is important to be certain the placement of plantings does not interfere with site visibility at intersections. For additional information about sight distance triangles, developers should refer to the Town's Standard Details. In general the following tree placement standards apply:

(1) Large Trees - All trees reaching a mature height of thirty five (35) feet or more should be planted a minimum of:

- 4 feet from back of curb, edge of street pavement and driveways (allow for any proposed future widening);
- 4 feet from sidewalks and other paved pedestrian surfaces except where urban conditions would prohibit any planting;
- 10 feet from all buildings;
- 15 feet from street lights, utility poles and above-ground utility wires;
- 15 feet from fire department connections and fire hydrants

(2) Small Trees - All trees reaching a mature height of less than 35 feet should be planted a minimum of:

- 3 feet from back of curb, edge of street pavement and driveways (allow for any proposed future widening);
- 3 feet from sidewalks and other paved pedestrian surfaces except where urban conditions would prohibit any planting;
- 5 feet from all buildings;
- 10 feet from street lights and utility poles;
- 10 feet from fire department connections and fire hydrants

6.2 PLANT SELECTION STANDARDS

The Town encourages the use of diverse plantings of native and well adapted non-native species in all landscaping projects. Because some species of plants have the potential to become invasive, however, there is a need for all landscape designers to carefully consider the risk of unintentional environmental damage when specifying exotic plant materials on planting plans. Below is a link to the list of plants known to be invasive in the Town of Chapel Hill. These plants are prohibited from use on Town-regulated planting projects. Also provided are several links to lists of native plant species which are specifically encouraged as substitutions for more commonly planted non-native species.

In addition to the information provided in the following lists of plants, landscape designers are encouraged to research their plant selections carefully to assure they are providing a diverse mix of species which will perform well on a specific project site. For additional information about local plant adaptability landscape designers can contact the North Carolina Botanical Garden and the J.C. Raulston Arboretum.

Consistent with these Town landscaping objectives, landscape designers are discouraged from planting large numbers of a single species in any given project and from using plant varieties, such as Red-tip Photonia and Leyland Cypress, which are prone to insect and disease problems. For additional information about susceptible plant species, landscape designers can contact the North Carolina Cooperative Extension Service.

Prohibited Invasive Exotic Species
Please refer to the: Invasive Plant Atlas of the United States for a list of invasive-exotic plants which cannot be specified for use on landscaping plans for development applications requiring planting plan approval by Town staff. The use of the listed plants is strongly discouraged in non-regulated landscaping projects within the Town. The Invasive Plant Atlas of the United States is a collaborative project between the National Park Service, the University of Georgia Center for Invasive Species and Ecosystem Health, the Invasive Plant Atlas of New England and the Lady Bird Johnson Wildflower Center. The purpose of the Atlas is to assist users with identification, early detection, prevention, and management of invasive plants. Species are added to the list periodically.

Recommended Native Species
Lists of plant species native to the Southeastern United States generally available in the nursery trade and are known to perform well in typical landscape installations in the Chapel Hill area may be found at:

- From the North Carolina Botanical Garden Native Trees and Shrubs for Your Garden
- From North Carolina State University Cooperative Extension Native Plants
- From United States Fish and Wildlife Service (for the Southeast) Native Plants for Your Backyard

Plants on these lists are recommended for inclusion in regulated and non-regulated landscape projects within the Town.

6.3 LANDSCAPE INSTALLATION AND MAINTENANCE SPECIFICATIONS

Material Requirements

Plant Materials
The American Standard for Nursery Stock ANSI Z60.1-2014 published by the American Horticulture Industry Association should be used for determining caliper, heights, spread and ball sizes for all plants. See www.AmericanHort.org.
Plant material should be free of any diseases, funguses or insect infestations.

Town standard minimum planting sizes are listed below. Larger sizes may be required, however, for specific landscape applications including parking lot screening***.***

Ground Cover:	2" pots
Shrubs:	18" in height
Small Trees:	5' in height
Large Trees:	2 caliper
Street Trees:	12' in height, limbed up to a minimum of 7' in areas of pedestrian traffic.

Topsoil Mix
All topsoil mixes used for finish grading and planter applications should be the site's original topsoil or should be tested by N.C. Department of Agriculture and Consumer Services to determine the soil's suitability for landscape use.

All topsoil mixes should contain a minimum 2% organic matter; range in pH from 5.0 - 7.0; and be free of herbicide and pesticide residues prior to the addition of amendments.

All topsoil mixes should be amended as determined by soil test results, and should be loose and friable at the time of planting.

Backfill for Planting Pits
Soil dug from the planting pit should be used for backfilling in order to avoid creating soil interfaces at the edge of the planting pitThe backfill may be amended to contain a maximum of 10% added organic matter. The backfill should be loose and friable at the time of planting.

Mulch
Mulch should consist of aged shredded hardwood installed at a consistent depth of 3-4 inches.

Soil Preparation

Tilling of Areas to be landscaped

Existing compacted top soils which are to receive plants, seed and/or subsoils which are to be overlaid with topsoil should be tilled to a minimum depth of 6", avoiding critical root zones of adjacent existing trees.

Placing Topsoil in Areas to be Landscaped:

All areas to be planted with turf, shrubs or trees should receive a minimum of 6" of topsoil over finished subgrade, avoiding the critical root zones of adjacent existing trees.

Planting Requirements

Planting Seasons

Trees and shrubs should be planted prior to May 15 and after September 15. Delayed plantings of required buffers and/or other landscaping can be accommodated with the acceptance of a letter of credit submitted to and approved by the Town Planning and Sustainability Department.

Weather Conditions

Digging and planting operations should be performed only when the soil temperature at each planting area and of all backfill materials is above 32 degrees F.
Following a period of precipitation, planting operations should resume only when the full depth of the planting pits has satisfactorily drained.

Handling Plant Materials

Shade and water should be provided to all delivered material during dry weather and B&B materials should be heeled-in with the root balls covered in mulch if they are to remain unplanted for over 24 hours.

Excavating Planting Pits

All planting pits should be excavated to a depth equal to or slightly less than the height of the planting ball. The sides of the planting pits should be loosened and roughened to facilitate the movement of roots into the surrounding soil.

Setting Balled-and-Burlapped and Container Plants

Planting height should be determined by the soil drainage characteristics of the planting site while allowing for some settling after planting. All plant material greater than three feet in height should be set plumb regardless of the slope of finished grade. Groundcover plants smaller than 3 feet in height may be set perpendicular to finished grade on sloping sites.

For container grown plants, carefully remove the container and cut any container-bound circling roots. For balled-and-burlapped plants, cut burlap away from the top half of the root ball. For plants in wire baskets, set plant in planting pit; then cut and remove wire from the top half of the root ball

Place and tamp backfill around root ball in six-to-eight inch layers up to the level of the finished grade. Avoid bruising or breaking roots when tamping the soil. Remove all protective wrapping from trunks and branches and thoroughly settle plantings with water.

Place a minimum of three inches of mulch over plant ball and pit area, taking care to keep material a minimum of two inches from the trunk of tree.

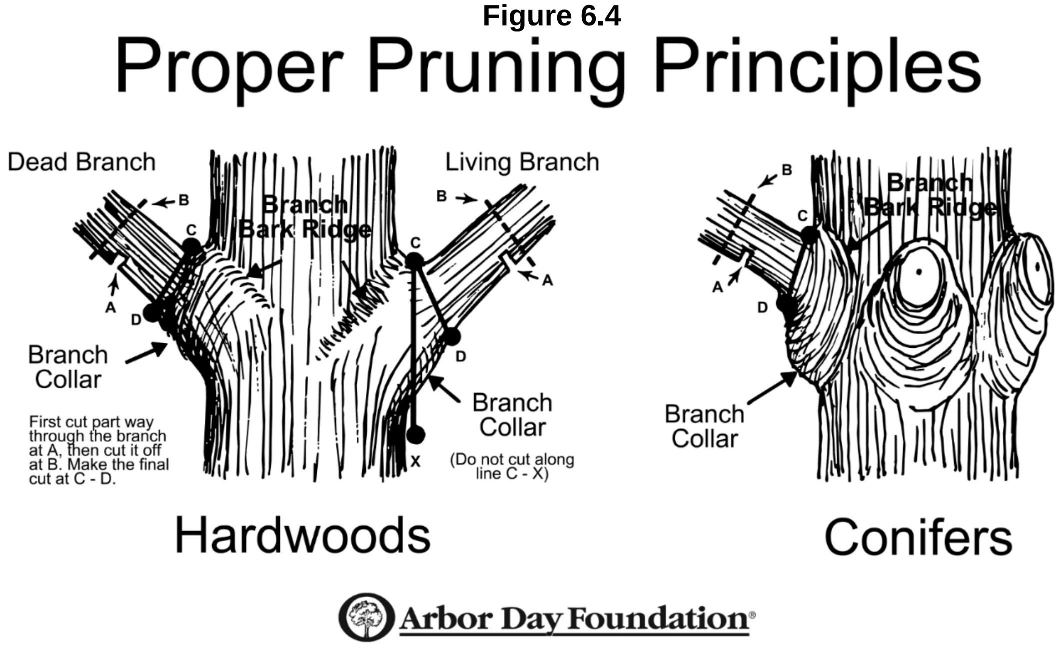
<u>Staking Trees</u>

Support should be provided only for trees greater than 8 feet in height planted in exposed locations. Trees should be secured using vertical stakes driven into the ground outside the planting pit with constraining lines made of webbing, hose-protected wire or other material which will not abrade or become embedded in the trunk. Slack should be provided in each constraining line to allow for some trunk movement. All supports should be removed after one year unless tree has a flexible leader such as an evergreen affected by windy conditions.

General Pruning Requirements

Pruning should consist of the removal of dead, dying, diseased, conflicting, obstructing and weak branches and selective thinning to lessen wind resistance and improve the appearance of trees and shrubs. All cuts should be made without leaving a protruding stub and without cutting into the branch collar or the branch bark ridge. Clean cuts should be made at all times.

Figure 6.4



Trees limbs too heavy to handle by hand should be precut above the final cut to prevent splitting or peeling of the bark. Where necessary to prevent tree or property damage, branches should be lowered to the ground with ropes or equipment.

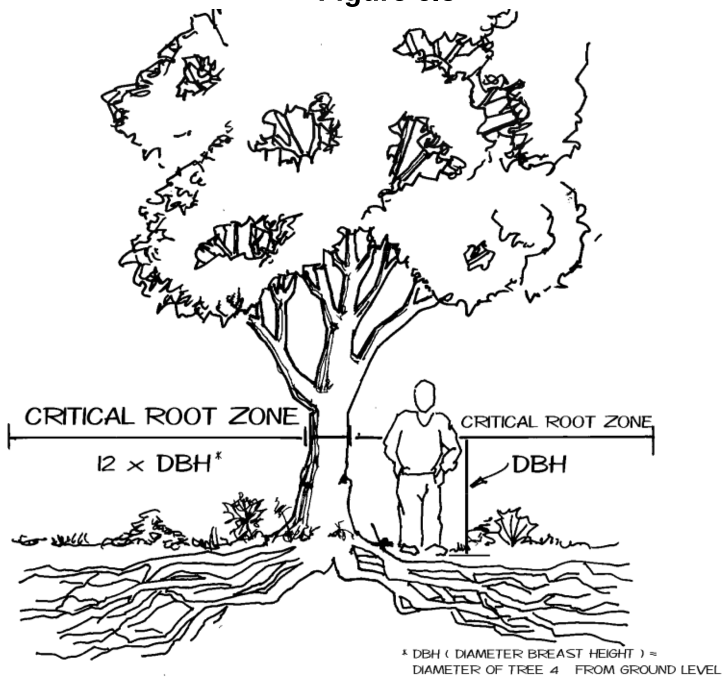
Treatment of cuts and wounds with tree wound dressing is discouraged except for cosmetic purposes in highly visible areas. If such treatment is made, materials non-toxic to the cambium layer must be used and care should be taken to treat only the exposed wood with a thin coat of dressing. Climbing spurs should not be used unless the tree is dead or is to be removed.

6.4 TREE PROTECTION STANDARDS

Tree Protection Ordinance Requirements

All development activities on non-exempt sites which involve disturbance to trees, or to the soil within the critical root zone of any tree, should conform to the provisions of a Landscape Protection Plan submitted to the Town for approval.

Figure 6.5



CRITICAL ROOT ZONE

<u>Landscape Protection Plan</u>

A Landscape Protection Plan should be prepared according to Section 5.7.3 of the Land Use Management Ordinance showing existing and proposed site conditions and areas to be protected during construction.

Existing conditions to be shown on the plan include areas of significant tree stands and other notable landscape elements of the development site, as well as the critical root zones of all rare and specimen trees which will be affected by construction. Significant trees stands are defined in Section 5.7.5 of the Town's Land Use Management Ordinance and generally include all wooded areas greater than 5000square feet in size with a continuous mature canopy - where over fifty (50) percent of the canopy is provided by hardwoods with a DBH of 24 inches or greater. Rare and specimen trees are defined in Section 5.7.6 of the Town's Land Use Management Ordinance and generally include all hardwood trees with a DBH greater than twelve (12) inches and all pine trees with a DBH of eighteen (18) inches or more. Certain native species such as Dogwood, Redbud, Beech, and Holly are included at 6 inches DBH.

The critical root zone of a tree is defined as: A circular area centered on the trunk of the tree, the radius of which is twelve (12) times the diameter (DBH) of the tree at 4.5 feet above grade Critical root zone is also equal to one foot of radius for every inch of trunk diameter.

The Landscape Protection Plan should also be on the proposed grading plan, should identify the construction limit line, and should indicate where tree protection fencing will be installed. In addition, the following standard notes and a detail of the proposed tree protection fencing should be included as part of the Landscape Protection Plan.

Town Standard Tree Protection Notes

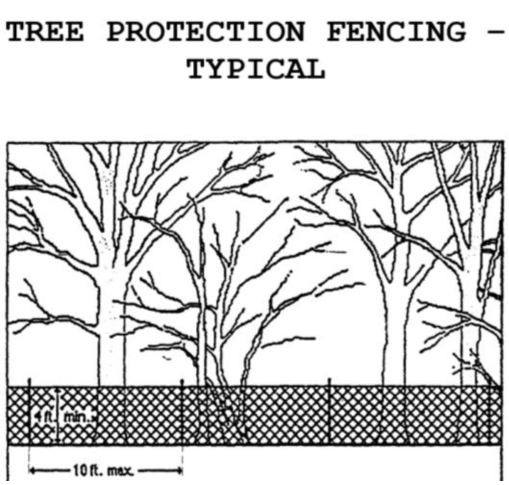
1. A pre-construction conference will be held with the Town's Urban Forester prior to beginning any work on site.
2. Any tree roots exposed by construction will be severed cleanly with an appropriate pruning tool.
3. The soil within the critical root zones of existing trees will not be driven on or otherwise disturbed during the installation of landscaping.

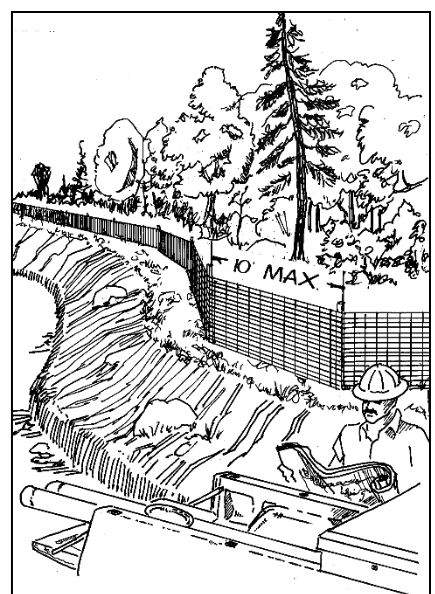
Tree Protection Fencing

To properly protect and ensure the health of existing trees to remain, protective fencing should be installed to protect no less than 75% of a tree's critical root zone. When erecting fencing near trees not individually identified on the Landscape Protection Plan, the fencing location should be shifted*,* where possible*,* or a tree removed if its critical root zone is not adequately protected. All land disturbing activity, storage of equipment, building material, soil and other debris should be kept within the area of development activity and outside of the protective fencing.

The Town's standard for tree protection fencing is orange woven plastic mesh or fabric with a height of four (4) feet installed on metal posts set a maximum of ten (10) feet apart as shown in the following typical detail.

Figure 6.6





TREE FENCING

In some situations, where silt fence is required to be installed along the construction limit lines, the silt fence is considered to function in lieu of the standard tree protection fencing; and therefore, the standard tree protection fencing is not required. Because silt fence installation requires cutting tree roots, it should be located outside critical root zones of protected trees.

Site Work Guidelines

Root Pruning Existing Rare and/or Specimen Trees
Root pruning is recommended prior to construction if digging, trenching or grading operations are to occur within the critical root zone of a rare or specimen tree. Root pruning is especially beneficial when undertaken during a tree's dormant season. If root pruning is indicated on the Landscape Protection Plan, it should be done with a root pruning or pavement cutting machine, or by trenching with appropriate equipment and cleanly severing all large roots without shredding the remaining roots.

Clearing and Grubbing
Trees and brush should be removed only in the areas indicated on the Landscape Protection Plan avoiding damage to limbs, trunks and roots of the remaining vegetation.
If tree protection fencing is damaged during the clearing operation, staging, or construction it should be repaired prior to the continuation of work. If trees fall inside areas shown as being protected on the Landscape Protection Plan they should be removed without the use of heavy equipment.

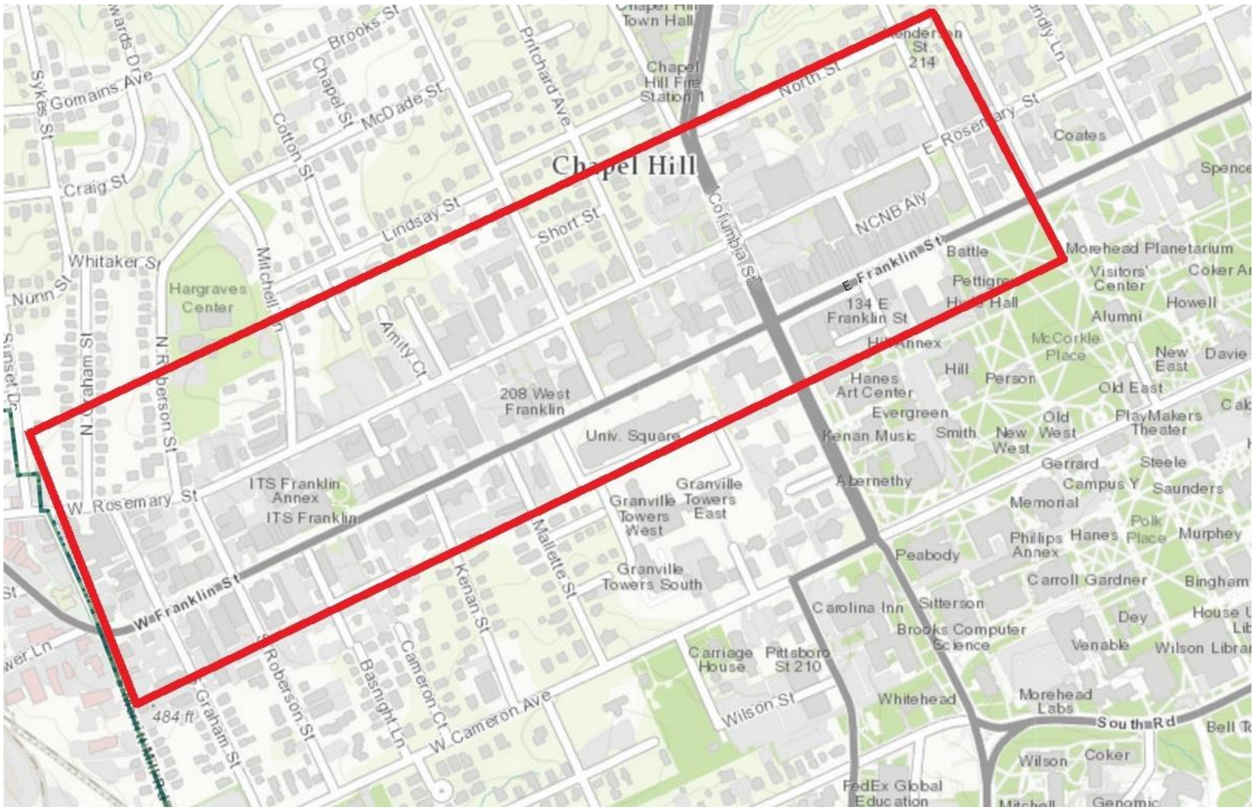
Construction Access within the Critical Root Zone of Rare and/or Specimen Trees
In limited situations where no permanent changes are proposed within areas of the critical root zones of rare and specimen trees but where these areas may be needed to access construction, a specialized root protection method may be required. This method involves the installation of logging mats over a bed of mulch to evenly distribute the weight of vehicles and equipment over the access route where it overlaps critical root zones. Where access through tree protection areas is proposed, protective measures should be clearly designated on Landscape Protection Plans.

6.5 STREETSCAPE STANDARDS

General

Projects located within the boundaries shown below in Figure 6.7 are subject to sidewalk, landscape, and lighting standards contained in the 2009 Downtown Streetscape and Lighting Master Plan:

Figure 6.7 – Downtown Streetscape and Lighting Master Plan



Materials, furnishings, and lighting standards are specified in the following sections. Any substitutions must be submitted in advance in writing accompanied by a sample for approval by the Town.

Streetscape Materials

<u>Brick</u>

All brick shall be:

1630 – red-flashed wire-cut modular face brick for retaining walls
1630-P red-flashed wire-cut modular paver brick
Ogee rowlock step tread for steps

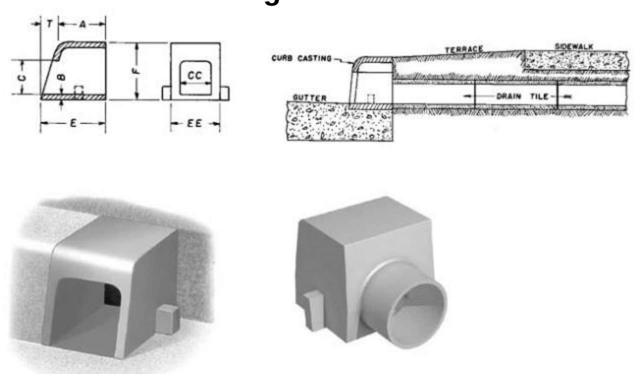
From: Triangle Brick Company, 6523 NC Highway 55, Durham NC 27713

Domed brick for handicap ramps - Adams Products domed red brick or equivalent red brick paver with truncated domes to meet current standards of the Americans with Disabilities Act.

Tree Pits and Grates

Structural soil for tree pits shall be: 70% Stalite expanded slate (‘PermaTill’), 30 percent sandy loam installed a minimum of 18 inches deep for the width of the brick amenity strip or as approved by the Town.

Figure 6.8



Rear view of R-3262-3 only. (optional)

Tree pit drains and roof drains extended into the public right-of-way shall be tied into subsurface storm water conveyances or catch basins. If no subsurface drainage system exists, curb openings for tree pit or roof drains shall be: Neenah Foundry Company R-3262-3 www.nfco.com or equivalent.

Tree grates are to be pedestrian safe with slot openings 1/4-inch in width or less or compliance with current ADA standards. Tree grates shall be:

4’ x 6’ rectangles (Model # R-8815-1) Metropolitan series made by Neenah Foundry
5’ x 5’ squares (Model # 8855) Sunray series by East Jordan Iron Works www.ejco.com
6’ x 6’ squares (Model #8856) Sunray series by East Jordan Iron Works

No light wells (some exceptions)
Cast iron, not painted
Removable center ring, where available

Adequate growing space between the tree trunk and first inner ring of the tree grate shall be provided to allow the tree to grow properly. The opening in the center of the tree grate through which the tree grows should be at least 18 inches in diameter at installation and provide 4-6 inches of clearance from the tree trunk. The tree should be centered within the tree grate opening.

If large-area tree grates are not available or cannot be used, the required permeable surface area may be provided by using multiple tree grates which are at least 4 feet wide or by providing natural permeable materials, such as landscaping pavers, over the planting pit surface. Any non-standard tree grate frame installation shall have adequate structural support and be approved by the Town’s Urban Forester.

Table 6.4 - Tree Grate and Tree Well Recommendations

Tree Species Size	Minimum Tree Grate Area (width x length)	Minimum Tree Well Volume (width x length x depth)
Small Tree	18 sq. ft. minimum 3' min. width (example 3' x 6')	120 cu. ft. minimum 3' min. depth (example 5' x 8' x 3'
Large Tree	32 sq. ft. minimum 4' min. width (example 4' x 8')	150 cu. ft. minimum 3' min. depth (example 5' x 10' x 3')

Structural soils can be used to attain adequate soil volume of the tree well. The growth of trees using tree grates should be monitored to ensure inner grate rings or the entire tree grate is removed as necessary to prevent constricting the tree's growth. Tree grates should be flush with the final surface grades and should be installed per the manufacturer's specifications.

Furnishings

The palette of Streetscape furnishings was developed for durability and simplicity:

Bike Racks shall be: Sunshine U-Lok Corp. http://www.sunshineu-lok.com Model: "Simple-Lok" Single loop Inverted "U" Bike rack, Black, in-ground installation (not surface-mount)

Trash Receptacle shall be: Victor Stanley Ironsites Series S-424 36-gallon capacity (includes liner), with standard lid, Victor Stanley green. Manufacturer's representative: Hasley and Associates, Charlotte, NC, (800)289-4183, www.victorstanley.com

Sidewalk recycling container shall be: Nex-terra, Single, 38-gallon capacity, Side load, Saturn-shaped opening, Slant top, Green with white lettering & chasing arrows recycling symbols

Combination Streetlight-Pedestrian light (ordered through Duke Energy

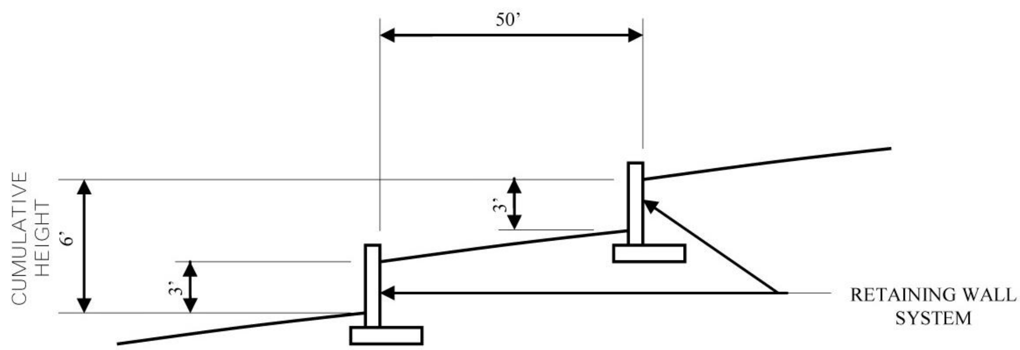
- Style "C" 25-foot cast aluminum fluted pole with decorative base on Rosemary Street and side streets
- Union Metal Octaflute steel tapered pole on a Denver style base on Franklin Street
- color RAL 6012 (Dark green)
- 150watt green LED Roadway Luminaire fixture on Davit arm and at 15' mounting height a 75 watt LED 'Bell' fixture on Davit arm

Pedestrian Lights: (ordered through Duke Energy)

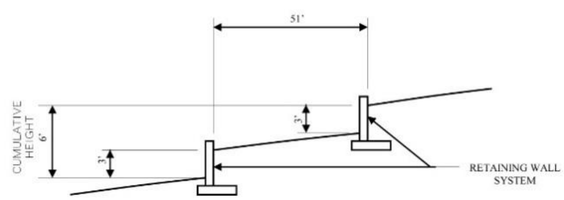
- Style "C" 15-foot cast aluminum fluted pole with decorative base on Rosemary Street
- Union Metal Octaflute steel tapered pole on a Denver style base on Franklin Street
- Color RAL 6012 (Dark green)
- 15' mounting height a 75 watt LED 'Bell' fixture on Davit arm

6.6 RETAINING WALLS

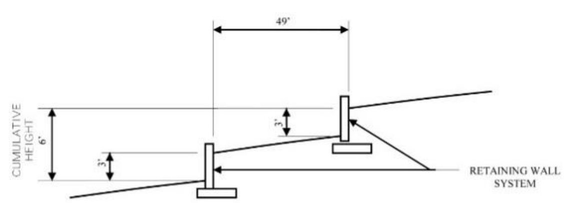
All retaining wall designs within publically-maintained street right-of-way and on Town of Chapel Hill property must be provided by a design professional licensed in the State of North Carolinain accordance with the North Carolina Building Code.



EXAMPLE - A
DESIGN PROFESSIONAL REQUIRED



EXAMPLE - B
DESIGN PROFESSIONAL NOT REQUIRED



EXAMPLE - C
DESIGN PROFESSIONAL REQUIRED

Chapter 7

Solid Waste Management

7.1 RESIDENTIAL COLLECTION

Residential refuse collection is provided by the Town of Chapel Hill Public Works Department for occupants of dwellings with five (5) units or less. In order to provide this service the owner or occupant of the residence is required to use roll-out containers available from the Town's Public Works Department. A maximum of two (2) containers will be collected from each residential unit and must be placed at the curb on collection days. Residents who cannot bring their containers to the curb for health reasons can contact the Public Works Department and apply for an exemption, allowing them to receive side or rear yard collection services.

In newly proposed residential developments all streets are required to be built to Town standards to assure refuse collection vehicles will have adequate access. Developers should refer to the Town of Chapel Hill Engineering Standard Details for vertical and horizontal curves, pavement sections, street widths and the dimensions of cul-de-sacs and T-turnarounds for this information.

Residential Refuse Collection Note:

- Certain refuse (paint, medical waste, etc.) cannot be collected from standard refuse receptacles. Residents are advised to contact the Town of Chapel Hill Public Works Department for additional information about refuse requiring special handling and refuse, yard waste, leaf, and white good collection schedules.

- Refuse, recycling, and yard waste containers along with loose yard waste piles may not be stored in the public street right-of-way and but be stored out of sight from the street or screened.

- Containers and loose piles shall be brought to the street and placed behind the curb or edge of pavement on the collection day and removed by 7:00 pm on the day of collection.

7.2 MULTI-FAMILY/COMMERCIAL/INSTITUTIONAL REFUSE COLLECTION

Multi-family development includes all sites zoned for multi-family use with apartment buildings, townhouses or condominiums with six (6) or more units. This includes complexes or groups of buildings which may individually have less than six (6) units but are located on a single zoning lot or have either shared driveways or common parking areas. Commercial and institutional development includes all sites zoned for commercial or institutional use which are not used for residential development.

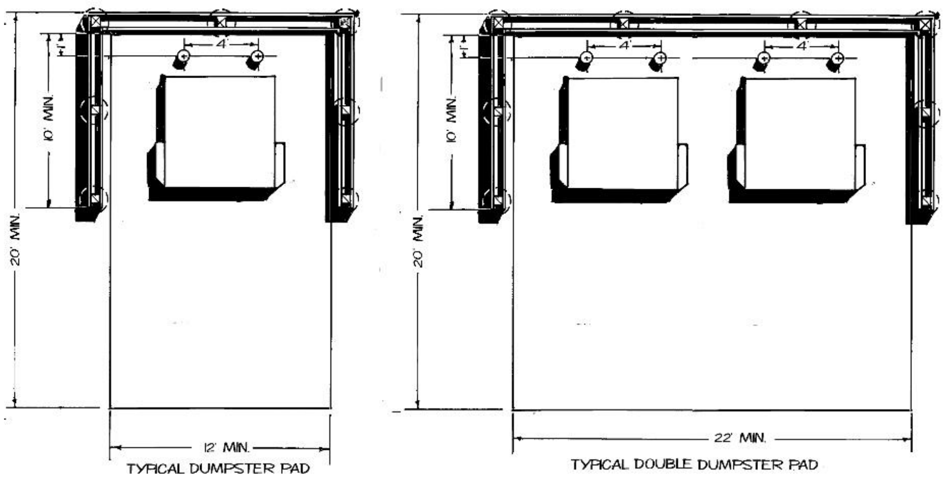
For some other commercial and institutional developments, it may be possible to share the use of an existing or proposed dumpster pad on an adjacent property. In these cases, a joint use agreement between the affected property owners will need to be developed, submitted to the Town Attorney for approval and recorded in the appropriate county Registrar of Deeds Office. In addition to this, the proposed site plan may need to include an accessible location for a possible future dumpster. This may also be required in other situations where an on-site dumpster pad, although not initially needed to service the anticipated quantity of refuse, may be required in the future.

- Roll-out service (regardless whether the provider is public or private) is prohibited for commercial and institutional entities with greater than five thousand square feet (5,000 sf) of floor area.

- Within large multi-family/commercial/institutional developments the use of roll-off compactors may be preferable to the use of multiple refuse dumpsters.
- In order to receive collection of food wastes, including preparation waste, extra portions, or plate scrapings, the owner or occupant of any food/beverage business is required to provide space for food waste collection container(s). This material is generally collected from roll cart type containers

Dumpster Pad Design

Figure 7.1



- Dumpster pads should be constructed of concrete with a minimum compressive strength of 3500 psi (5000 psi recommended).
- For a typical single dumpster, the pad should be 12' wide and 20' deep.
- For two dumpsters, the pad should be 22' wide and 20' deep.
- The pad apron should be a minimum of eight (8) inches thick.
- Two concrete filled 6" I.D. steel pipe bollards should be installed 4' apart and 1' from the rear edge of the pad behind each dumpster to protect the adjacent screening materials. These bollards should be set in concrete footings a minimum of 2' in depth.

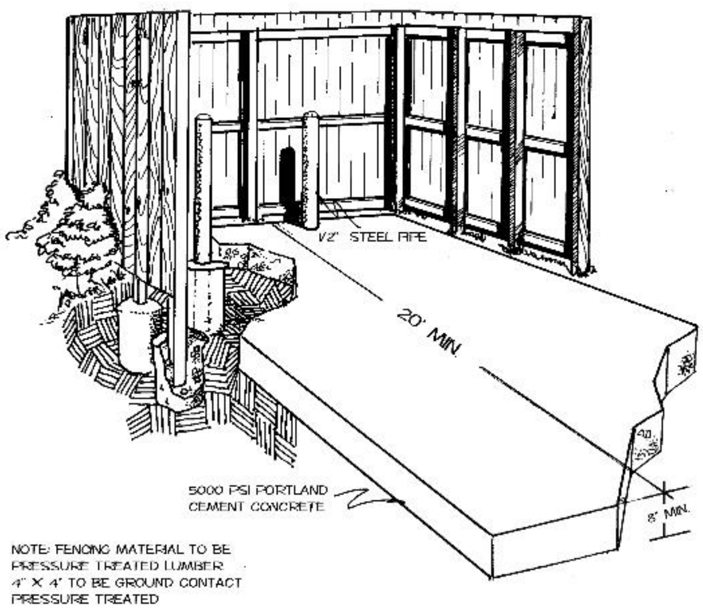
Dumpster Pad Screening

- All dumpsters are required to be screened on three sides. Typically this includes screening the full width of the rear of the pad and 10' along either side.
- If gates are proposed to screen the front of the dumpster(s) they should be installed with retainers to keep the gates in the open position during servicing and the use of this hardware should be noted on the development plans.
- All gates should be dimensioned to provide a minimum clear width of 12' to service each dumpster.
- Town staff is not responsible for unlocking, opening, or closing gates for collection service.
- Additionally, if the box is enclosed with gates it is recommended at pedestrian user access

be provided in addition to the service gates.

- Screening can consist of stone, block, brick, wood or a combination of these materials. The screen should be designed and landscaped so it is consistent with the Town's Landscaping Standards.
- The screen should be a minimum of 7' in height and should be located directly adjacent to the dumpster pad.
- In some cases, the use of plantings alone to screen the dumpster may be acceptable if they are planted at a size which will permit them to reach the required minimum height within one growing season.
- The most common type of screening used is a wooden privacy fence.

Figure 7.2

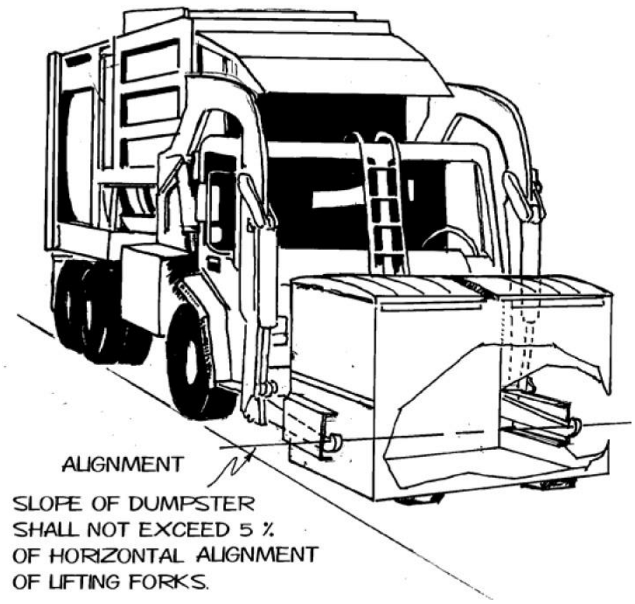


STANDARD DUMPSTER PAD WITH FENCING

Where refuse collection vehicles will need to turn around to exit a development site, the site plan should be designed so backing movements do not exceed 100' in length. In these cases the turnaround area should be dimensioned using a turning radii template of the appropriate scale. In all cases, the proposed site plan should be designed so refuse collection vehicles do not need to back on or off of any public street or over any public sidewalk.

Where dumpsters are proposed to be placed at an angle to the centerline of the driveway or drive aisle the angle should not exceed 30 degrees. On sloped sites, the vehicle approach to the dumpster should be at the same slope as the dumpster pad and should not exceed 5 percent – see Figure 7.3, below.

Figure 7.3



In newly proposed multi-family, commercial and institutional developments all driveways and drive aisles are required to be built to Town standards. Drive aisles proposed to be used for refuse collection vehicle access shall be constructed with a minimum section of 10-inch stone base and 3-inch asphalt surface. Developers should refer to the Town of Chapel Hill Engineering Standard Details for driveway cut specifications, vertical curve requirements and pavement sections.

Overhead Clearance

- Electrical service drop connectors and other overhead utility wires are required by the National Electric Safety Code to allow 18 feet clearance over all public streets and over private driveways subject to truck traffic.
- If a dumpster pad is proposed to be located in an area which requires the refuse collection vehicle to drive under wires, the development plans should indicate the wires will meet this standard.
- In addition, if refuse collection vehicles must drive below awnings, canopies or other structures to access a dumpster, these structures should also be a minimum of 14'6" in height.
- In the immediate vicinity of the dumpster pad the minimum height clearance is 24'.
- Overhead clearance is required for refuse collection vehicle directly above the container.

Figure 7.4

Multi-family/Commercial/Institutional Refuse Collection Note

- Certain refuse (yard waste, white goods/bulky items, paint, corrugated cardboard, medical waste, etc.) will not be collected from standard dumpsters.
- Owners/occupants of developments receiving dumpster collection service are advised to contact the Town of Chapel Hill Public Works Department for additional information about refuse requiring special handling and refuse collection schedules.

7.3 RECYCLING

Recycling services for residential, multifamily, and commercial/institutional properties within the Town of Chapel Hill are provided by Orange County through the county Solid Waste Management Department pursuant to their recycling program policies and guidelines. For further information including design standards and development guidelines contact the Solid Waste Management Department at 919-968-2788 or visit their webpage at the following link: http://www.orangecountync.gov/departments/solid_waste_management/index.php
.

Chapter 8

Erosion and Sediment Control

8.1 GENERAL

All projects which disturb more than 20,000 SF within the Town of Chapel Hill and its Extraterritorial Jurisdiction (ETJ) must have an approved Erosion and Sedimentation Control Plan and Permit from NC DEMLR or Orange County Planning and Inspections. Residential single family homes, and projects that disturb less than 20,000 SF, are still required to provide erosion control measures. At a minimum these measures should include a construction entrance and silt fencing along downhill slopes of the site.

Information on erosion and sedimentation control design standards and permitting can be found in the NC DEQ's *Erosion and Sedimentation Control Planning and Design Manual*, latest edition. Permitting requirements for Orange County can be found at: http://www.orangecountync.gov/departments/planning_and_inspections/erosion_control.php.

The following is a summary to assist applicants in proper submittal of an erosion control plan to Orange County within the Town of Chapel Hill.

Reference the Orange County website http://www.orangecountync.gov/departments/planning_and_inspections/erosion_control.phpfor application links and guidance on proper submittal of an erosion control application and plan.

CAUTION: Any timbering, demolition, clearing, grading, or land-disturbing activity associated with land development before the erosion & sedimentation control plan is approved constitutes a violation, making the responsible party not only subject to civil penalties but the erosion & sedimentation control plan review and land disturbance permit subject to double fees. The enforcement of these penalties is discretionary and to a great extent depends on the circumstances surrounding the violation, including intent and the history of the parties involved.

1. **Confirm that the project is in the Town of Chapel Hill jurisdiction**. If so, the corresponding stormwater plan, if required, will be administered by the Town of Chapel Hill stormwater program staff. Tree protection will also be overseen by Chapel Hill staff.
2. **Determine if an erosion control plan is required for the project**. First determine the area of land disturbance associated with the project. NOTE: Do not include land disturbance for wells and/or on-site sewage disposal systems.
3. The next step is to **refer to the land disturbance thresholds for erosion control** in the Orange County Watershed Matrix (reference the Orange County Erosion Control web page**). If exceeded, an erosion control plan must be submitted for review, approval and subsequent issuance of a land disturbance permit.**
4. The level of design needed for your erosion control plan will depend on specific project conditions. There is no statutory requirement that erosion and sedimentation control plans can be designed by a registered Professional Engineer (PE) or any other licensed/certified person; however, persons with these licenses and/or certifications are often qualified to prepare erosion and sedimentation control plans. In addition, these plans can become quite complex and involve design elements that do classify as "engineering" work; therefore, requiring they be designed by a qualified PE.

5. Erosion & sedimentation control plans (sketches) for land disturbance projects of less than an acre, in general, need to illustrate the following:
   a. Base plan can be a to-scale printout from the Orange County GIS.
   b. Delineation and annotation of the various components of the project (i.e. structures, driveway, etc.).
   c. A designated temporary gravel construction entrance. This is normally where your driveway is going be constructed. The main concern is to ensure no off-site tracking of sediment, mud, etc.
   d. Silt fencing with silt fence outlets downhill of all land disturbance (Refer to Detail 6.62 Sediment Fence from NC DEMLR DEQ Erosion and Sediment Control Planning & Design Manual). The main emphasis is to ensure the bottom of the sediment fencing is secured below grade and the fencing locations cover the area downhill of the planned disturbance.
6. Mandatory Performance Standard for Erosion Control within the Town Limits: Each sediment basin or trap shall be designed to contain the 25-year storm peak inflow.
7. **Bona Fide Farm Projects**. Please supply Orange County with an Orange County Bona Fide Farm Exemption Affidavit Pursuant to N.C.G.S. 153-340(b), along with a current farm number, if that has been issued and is being utilized for farm status. The affidavit is available from the County Attorney and is also linked on the Orange County Erosion Control web page. Bona fide farm status may exempt portions of the site development associated with farm uses. The applicant is encouraged to schedule a pre-application meeting or at least a telephone consultation to discuss specific details of the required submittal. NOTE: THIS AFFIDAVIT IS YET TO BE ADAPTED FOR EROSION & SEDIMENTATION CONTROL AND APPROVED BY THE COUNTY ATTORNEY. THE LANGUAGE ABOVE UNDER 6 IS SUGGESTED TEXT AND PROCESS
8. Provide surface water identification (SWID) for any properties containing "questionable" or **potentially jurisdictional (intermittent or perennial**) **streams.** This would be streams shown on a USGS map as blue line streams in which the property owner only observes water flowing during storms. Surface water identification (SWID) is a service for which Orange County staff members are trained and certified; however, it should be noted that USACE reserves the right to confirm Orange County SWID's for permitting stream crossings. The existence of a "jurisdictional stream" on your property affects development potential, imposes constraints and additional permitting/time lines. Riparian stream buffers must be maintained, if a stream is jurisdictional, and any impacts must be minimized and sometimes mitigated.
9. **Stream crossings** are regulated on a site specific basis and may require additional (404/401) permitting by the U.S. Army Corps of Engineers (USACE) and the North Carolina Department of Environmental Quality (NCDEQ). A land disturbance permit cannot be issued until copies of the USACE 404 Permit and NCDEQ 401 Water Quality Certification are provided to Orange County Erosion Control.
10. Orange County offers free **pre-application meetings** and highly recommends this process, especially for those who have not permitted land disturbance in Orange County previously.
11. **Erosion and sedimentation control plans are submitted directly to Orange County** and can be processed concurrently with your site plan

application to the Town of Chapel Hill.

12. Upon receipt of your complete erosion and sedimentation control plan application package by Orange County, **Orange County staff will notify Chapel Hill by e-mail that your application has been received and is under review.** It is highly recommended that a copy of the transmittal to Orange County and one set of the erosion and sedimentation control plans be submitted along with your stormwater management plan submittal to the Town of Chapel Hill, as reference, to assist with their stormwater management review and approval.
13. **Stormwater management plans are to be submitted directly to the Town of Chapel Hill. One copy of these plans should be submitted to Orange County, as reference, to assist with complete erosion and sedimentation control review.**
14. **Upon approval** of your erosion and sedimentation control plan(s), Orange County will e-mail the approval package to the engineer of work, the applicant, and stakeholders at the Town of Chapel Hill.

Lessons Learned

- A pre-application meeting can save time and effort for both the applicant and reviewer. A sketch plan or concept plan with an estimate of disturbed acreage in hand will help this meeting be as productive as possible.
- Do not harvest trees within Chapel Hill's jurisdiction, prior to obtaining a land disturbance permit.
- Temporary top-down dewatering sediment basin and permanent stormwater control measure (SCM/BMP) can often be co-located.
- Pay close attention to a logical and constructible sequence of construction (i.e. don't specify installation of sand filters or bio-retention basins before a site is stabilized).
- The Applicant shall provide a copy of the approved plan and permit to the Town before final approval of construction drawings.

Directories of Licensed/Certified Individuals

The following are provided as references:
NC Board of Examiners for Engineers & Surveyors: http://www.ncbels.org/
NC Board of Licensed Soil Scientists: http://www.ncblss.org/
Certified Professionals in Erosion and Sediment Control: http://www.cpesc.org/

8.2 MANDATORY STANDARDS FOR PERMANENT GRADING

Soils in the Chapel Hill area tend to be fairly erodible due to steeper slopes and less soil cohesion. Erosion is increased when vegetation is removed from the land's surface or when the surface is disturbed by digging or movement of heavy equipment. In a steep area, even a small amount of land disturbance can lead to the formation of deep gullies unless steps are taken to cover and stabilize the soil. Each sediment basin or trap shall have a minimum volume of 3,600 cubic feet per acre of disturbed area and a minimum surface area of 435 square feet per cfs of Q25 (25-year storm) peak inflow.

- Proposed street right-of-way shall be graded to their full width for ditch and type of street and a minimum of eight feet behind the curb for curb and gutter sections.

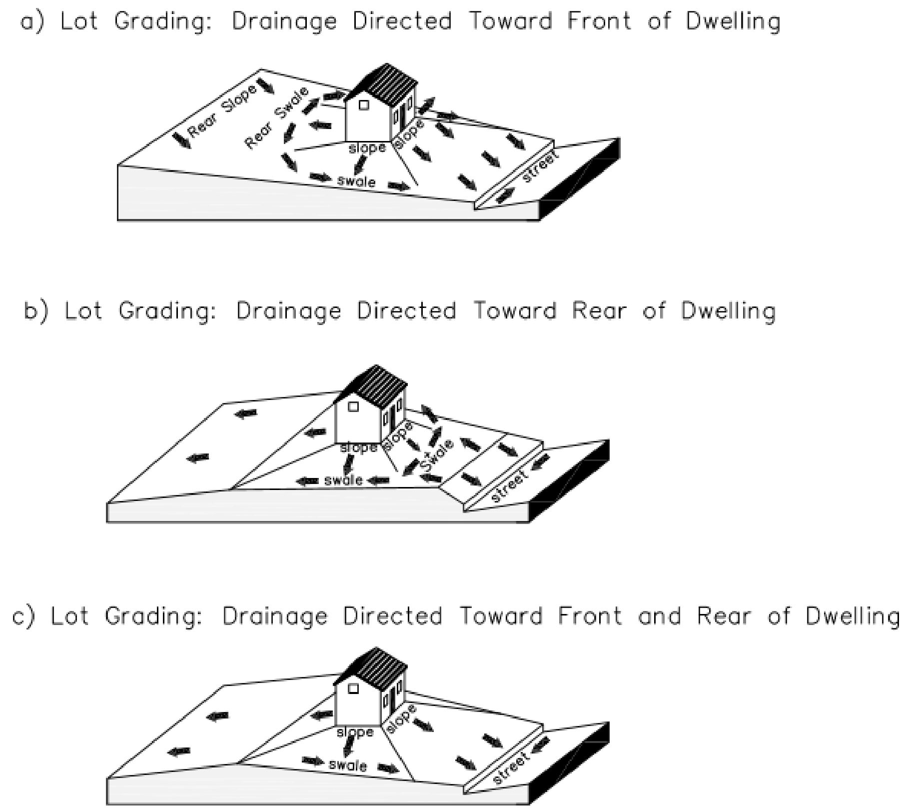
- Fill embankments shall be constructed in accordance with section 235 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures and placed in successive lifts not to exceed more than six inches in depth for the full width of the cross-section, including the width of the slope area.
- No stumps, trees, brush, rubbish or other unsuitable materials or substances shall be placed in the right-of-way.
- Each successive six-inch layer shall be thoroughly compacted by the sheep's-foot tamping roller, 10-ton power roller, pneumatic-tired roller, or other methods approved by the Town Engineer.
- Embankments over and around all pipe culverts shall be of select material, placed and thoroughly tamped and compacted as directed by the Public Works/Engineering Division representative.
  All final graded slopes shall comply with these standards.
- No cut or fill greater than ten (10) vertical feet shall be made which creates a slope steeper than three to (3:1) unless approval is granted during plan review by the Public Works/Engineering Division.
- No cut or fill less than ten (10) vertical feet shall be made which creates a slope steeper than two to (2:1) unless approval is granted during plan review by the Public Works/Engineering Division.
- The angle for graded slopes and fills shall be no greater than the angle which can be retained by vegetative cover or other adequate erosion control devices or structures.
- The angle for graded slopes and fills must be demonstrated to be stable. Stable is the condition where the soil remains in its original configuration, with or without mechanical constraints. Mechanically stabilized slopes, including but not limited to riprap, cribs, timber or masonry retaining walls, shall not exceed ten (10) feet in height without intervening terraces ten (10) feet in width with a maximum slope of three to one (3:1).
- With prior approval of the Public Works/Engineering Division, the ten (10) foot height limit for mechanically stabilized slopes may be increased for:
  - Wing walls with earth retaining devices.
  - Wing walls allowing subgrade access and other earth retaining devices required for the structural support of buildings, bridges, dams, culverts, or similar structures.
  - Stormwater channels. (Mechanical stabilization is required for engineering stormwater channels).

8.3 DRAINAGE REQUIREMENTS AROUND RESIDENTIAL STRUCTURES FOR SUBDIVISIONS

- A detailed grading plan for residential development shall be submitted with construction plans for the storm drainage system (with the exception of residential developments with over 20,000 SF lots and ribbon paved streets).
- The detailed grading plan shall include, among other things, consideration of and provisions for adequate drainage of surface water between, around and away from residential living units.
- Finish grading in the vicinity of the building foundation shall result in a minimum slope away from the building of six (6) inches in 10 feet and be in compliance with the most current requirements of the North Carolina Building Code.
- Shallow, grassed drainage swales provided to transport surface water drainage between, around and away from the residential building shall have a minimum slope of one (1) percent.

- If drainage swales having a minimum slope of one (1) percent are not feasible, then a pipe system shall be installed of sufficient design capacity to carry the runoff.
- All storm drainage intended to transport storm water runoff between, around and away from residential structures shall have a hydraulic design capacity sufficient to carry a 10-year storm event. See Figure 8.1 below.

Figure 8.1
Schematic Design for Grading for Drainage around a Building



Note: Figure copied from "Land Development Handbook", Second Edition.

Chapter 9
Parks and Recreation

9.1 GENERAL

The Town of Chapel Hill is nationally regarded for its quality of life. In addition to its parks, open green spaces, and a myriad of indoor and outdoor recreational facilities, the Chapel Hill Parks & Recreation Department offers recreational programs and cultural activities for all ages and social backgrounds. Public parks and recreation are the gateways to a healthier, more livable community.

Everyone needs the opportunity for self-enrichment, adventure, fellowship and quiet reflection. At Chapel Hill Parks and Recreation Department, we understand these needs and are dedicated to providing cultural and recreational opportunities in a safe and inviting environment.

The Town adopted its most recent Comprehensive Parks Plan (2013 – 2022) on May 29, 2013. This Comprehensive Parks Plan will help ensure that the Town Council, Parks and Recreation Department, and citizen leaders have a road map to guide decision-making and actions as the community grows and becomes more urban. It will provide a ten year vision (2013-2022) for the Department. This guide was carefully crafted by staff, the public, volunteers, and with the help of outside experts to ensure that future generations will have adequate parks, trails, and open space.

Dedication of Recreation Area (Subdivisions)
Minimum requirements for land to be dedicated as Recreation Area in the case of subdivisions must meet all minimum requirements listed in the Town's LUMO, Chapter 5.5 Recreation, and in the following Town and Construction Standards for Park Facilities (Design Standards).

a) Provision or dedication of Recreation Area is not required for a minor subdivision.
b) The purpose of Recreation Area is to provide either:
    - Active recreation on site which will provide real and meaningful recreational experiences for the residents of the development.
    - A suitable parcel of land which could be converted to active recreational use in the future, if the residents of the development so desire.
    - In some cases the preservation of greenway corridors or exceptional natural areas.
c) In general, Recreation Areas shall be located outside of the Resource Conservation District. Exceptions may be made for areas which protect high quality natural areas or greenway corridors.
d) Recreation Area is often not developed during the initial development of the subdivision. However, the land dedicated must have the character, shape and location suitable for use as a playground, playfield, or for other active recreation purposes including greenway pedestrian and non-motorized vehicle easements. Recreation areas shall be located on land which is relatively flat and dry and is otherwise capable of accommodating active recreation uses. Exceptions to the "flat and dry" requirement may include:

- Sites abutting or including areas designated as future greenways. In most cases the Town Council will require easements to be provided which will allow the Town the authority to build and maintain trails and public use of the greenway area.
- Important natural areas which would be best protected within a Recreation Area. This exception is not intended as a method of allowing developers to build on flat and dry areas while offering less desirable sites as Recreation Areas. Sites qualifying for this exception must have true merit as high quality natural areas.

e) Recreation Areas and Recreation Spaces shall be conveniently accessible to all residents of the subdivision and, other than greenway pedestrian and non-motorized vehicle easements shall have at least fifty (50) feet of frontage on at least one public street within the subdivision.

f) In most cases land provided for Recreation Areas shall be in the form of a single parcel. In rare cases the Town Council may determine two (2) or more parcels are more suitable to the needs of a particular subdivision. In such cases the Town Council may require such parcels be connected in some manner to promote pedestrian and bicycle connectivity.

g) In most cases the developer of small subdivisions will be asked to provide 100% of their required Recreation Area as a payment in lieu since the dedication of very small Recreation Areas in general will not provide meaningful opportunities for recreation. As a general guideline, developments which have required Recreation Areas of less than 2,000 square feet will be asked to provide 100% of the requirement as a payment in lieu.

Dedication of Active Recreation Space (Multi-Family Development)

Minimum requirements for land to be dedicated as Recreation Space in the case of multi Family developments must meet all minimum requirements listed in the Town's LUMO, Chapter 5.5 Recreation, and in the following Town and Construction Standards for Park Facilities (Design Standards).

a) The purpose of Recreation Space is to provide either:
   - Active recreation on site which would provide real and meaningful recreational experiences for the residents of the development.
   - In some cases the preservation of greenway corridors or exceptional natural areas.

b) In general, Recreation Space shall be located outside of the resource conservation district. Exceptions may be made for areas protecting high quality natural areas or greenway corridors.

c) Recreation Space must be developed during the initial development of the subdivision.

d) Recreation Space must be located on land suitable for the active recreation use proposed for the development.

e) Recreation Space shall be conveniently accessible to all residents of the development.

f) Recreation Space may be in the form of a single active recreation amenity or multiple sites and amenities depending on the nature and size of the development.

g) The Town Council may allow up to thirty (30) percent of the recreation space to consist of passive recreation elements if they are located adjacent to and support the more active recreation elements. For example, some picnic facilities, seating, and lawn games could be counted if they are adjacent to a children's play area and support the mission of the play area.

h) The Town Council may waive suitability requirements in order to preserve greenway corridors or important natural areas.

i) In most cases the developer of multifamily developments will be asked to provide a minimum of 25 percent of their required Recreation Area as a payment in lieu. These funds will be used to make capital level improvements to public recreation amenities which will serve the development. The requirement may be higher than 25 percent if the development does not have the land required to provide meaningful recreation amenities which will truly serve the recreational needs of the residents. The Town has enabling legislation for this requirement.

j) All active recreation space amenities must adhere to requirements of the [Americans with Disabilities Act.]

k) Recreation space shall be improved with recreation facilities designed for active play. All recreation space improvements must be built or installed using standards generally accepted for each type of amenity. Examples of acceptable active play facilities include:

- Playgrounds utilizing commercial grade play equipment and adhering to national safety standards for play equipment and fall surfaces. Refer to national safety standards.
- Ballfields and athletic fields designed and built for active recreation. Such fields must be properly graded and have appropriate turf, goals, sub-drainage, benches, and other amenities commonly required for the intended sport. Unimproved open grass areas are not considered to be athletic fields.
- Basketball courts installed with regulation goals and in hard surface court areas large enough to sustain regulation play. Half courts are acceptable. Basketball goals installed in a street or parking lot are not acceptable.
- Swimming pools and bathhouses. – refer to County standards created by the state
- Tennis, elevated bocce, and pickle ball courts.
- Community gardens appropriately designed and constructed with at least five (5) percent of the garden area consisting of raised beds for handicap users, a source of water throughout the garden area, storage area for tools, deer protection fencing, handicap accessibility, and access for maintenance. Community gardens will only be acceptable under the following conditions:
    - Dwelling units have no yards or yard areas too small to garden in a reasonable manner.
    - The garden area is reasonably centrally located.
    - The garden area has reasonable access for all residents.
- Clubhouses intended to be owned by a homeowners' association and operated for the recreation needs of the community. If the building is shared by a sales or management office, the space used for those activities will not count toward Recreation Space requirements.
- Exercise rooms within an apartment, condominium, or other such building intended to be used by the residents for recreation purposes.
- Ponds improved to support fish, stocked with fish, and improved to allow fishing access by persons with disabilities. If the ponds are required for stormwater or other purposes, only those features directly related to fishing may be counted.
- Roof top running tracks or other active facilities are permitted. However, any such roof top facilities must have significant separation from HVAC units. The developer must show the recreation facility would not be negatively impacted from heat and noise generated by such units.
- Paved greenway trails which are designated as future greenways on the town's comprehensive plan, greenway project conceptual plans adopted by the council, greenway project master plans adopted by the council, or greenway trails which would offer significant pedestrian and bicycle interconnectivity. Standalone paved trails that do not directly connect into the Town's greenway system or make significant direct connections to important destinations must be at 2,500 linear feet or longer. Greenways along creeks must be built with

concrete paved greenways must be able to support maintenance and emergency vehicles.
- Unpaved trails of a length which provides a meaningful recreation experience. Generally three thousand (3,000) linear feet or longer. Exceptions can be made for shorter trails that connect directly into an existing trail system or a trail system shown in a Town plan.

L) Dog parks intended for the residents and built with commercial grade fencing, double gate entry, waste disposal systems, water source, and seating. Dog parks will be acceptable for developments of at least 100 dwelling units.

M) Examples of facilities which will not be considered as acceptable as Active Recreation Space:
- Open lawn areas.
- Large expanses of unimproved space between or around active recreation elements.
- Picnic tables and picnic facilities.
- Seating areas.
- Areas dedicated to lawn games such as badminton, croquet, lawn darts, horseshoes, etc.
- Areas dedicated to table top board games.
- Gardens not improved for active gardening by the community.
- Orchards.
- Sidewalks, stairwells, parking lots, stormwater detention areas, and other facilities required for development of the project.



Playgrounds and Play Amenities

The following are minimum requirements for playground equipment, specifications and installation at the goal of this section is to require high-quality play equipment that will provide a fun, safe experience for users with low maintenance issues and costs by the ultimate owners and operators.

The following are minimum requirements for playground equipment, specifications and installation at all park, Recreation Area, and Recreation Space sites.

1) General

a) All playgrounds and swings must be of commercial quality; no exceptions will be made.

b) Acceptable playground manufacturer fastening types:
- Clamp type fastening system for components to main structure.
- Direct-bolt type fastening system for components to main structure.

c) All play areas must have an accessible path of travel (wood fiber, rubberized resilient poured-in-place surfacing or tiles).

d) Equipment and components to be IPEMA certified.

e) Equipment manufacturer to comply with ISO 9001 and ISO 14001.

f) Equipment manufacturer to provide installation manual and playground layout at completion of project: hard copy and digital file.

g) Equipment and fall surfacing must comply with current Standards and Guidelines as listed:
- CPSC Handbook for Public Playground Safety, Pub. No. 325.
- ASTM F 1487 Standard, Consumer Safety Performance Specification for Playground Equipment for Public Use.
- ASTM F 2223 Standard, ASTM Standards on Playground Surfacing.
- ASTM F 2373 Standard, Performance Specifications for Public Use Play Equipment for Children 6 months through 23 months.
- ASTM 1292 Standard Specification for Impact Attenuation of Fall Surfacing Materials.
- Accessibility Guidelines for Play Areas as described in ADAAG.
- *ANSI Standards:* Z535.1 Safety Color Code, Z535.4 Products Safety-Signs and Labels.
- *Federal Standards:* 16 CFR Part 1303, 16 CFR 1500 – Including Sections 1500.48 and 1500.49, 16 CFR Section 1501, 36 CFR Part 1191.
- *UL Standards:* UL 969 Standard for Safety: Marking and Labeling Systems
- *CSA Standards*: CAN/CSA-Z614 Children's Play Spaces and Equipment.

h) Equipment installation shall be performed by a Certified Playground Safety Inspector in good standing. Contractor shall be National Playground Safety Institute (NPSI) - Certified.

i) Equipment to have safety use (fall) zone as required by ASTM F-1487 Standards.

2) Definitions

a) Standards and Guidelines: applicable standards and guidelines will include but not be limited to most current editions of: ASTM F-1487; ASTM F-2223; ASTM 2373; CPSC Pub. No. 325; USATBCB Guide to ADA Accessibility guidelines for play areas. (Will be referred to ASTM and CPSC as applicable.) put link to ASTM website

b) Composite Play Structures: According to ASTM F 1487, this means "two or more play structures attached or functionally linked," creating one integral unit with more than one play activity.

c) Critical Height: According to CPSC No. 325, this means "the fall height below which a life-threatening head injury would not be expected to occur."

d) Fall Height: According to ASTM F 1487, this means "the vertical distance between a designated play surface and the protective surfacing beneath it." The fall height of playground equipment should not exceed the Critical Height of the protective surfacing beneath it as set forth by play activity or specified critical fall height, whichever is more restrictive.

e) IPEMA: International Play Equipment Manufacturers Association.

f) Play Structure: According to ASTM F 1487, this is "a free-standing structure with one or more components and their supporting members."

g) Protective Surfacing: According to ASTM F 1487, this means “impact-attenuating materials to be used within the use zone of any playground equipment" for playground surface systems. See Specification below.

h) Use Zone: According to ASTM F 1487, this is "the area beneath and immediately adjacent to a play structure which is designated for unrestricted circulation around the equipment and on whose surface it is predicted a user would land when falling from or exiting the equipment."

3) Required Certificates

a) Product Certificates: Signed by manufacturers of playground equipment certifying products furnished comply with all requirements set forth in specifications and/or construction drawings.

b) Installer Certificates: Manufacturers Certification and NPSI Certification.

c) Manufacturer Certificates: IPEMA Certification of playground equipment and components.

4) Quality Assurance

a) Equipment installation to be performed by National Playground Safety Institute Certification (NPSI) - Certified Playground Safety Inspector, in good standing.

b) All hardware, equipment, and components must be IPEMA certified and compliant with all specifications as set forth herewith.

c) Manufacturer Qualifications: A firm whose playground equipment, components, and hardware have been certified by IPEMA's "3rd Party Certification" service.

d) Provide only playground equipment and play structure components bearing the IPEMA Certification Seal.

e) Standards and Guidelines: Provide playground equipment complying with or exceeding requirements in the following:

- ASTM F 1487: To include warning labels, manufacturers identification
- CPSC No. 325, "Handbook for Public Playground Safety."

5) Playground Fall Surfacing

a) Engineered Wood Fiber shall comply with most current versions of ASTM-1292 and ASTM-F 1951 and F 2075.

b) Playground Safety Tiles shall comply with most current versions of ASTM F1292, CPSC Handbook and ADAAG Standards.

c) Resilient Poured-in-Place Rubber Surfacing must be in compliance with latest ASTM F1292, F1487, F2479, CPSC Handbook and ADAAG Standards

Dog Parks

1) General

a) Dog parks are to be designed to assure the safety and comfort of dogs, owners, and nearby residents.

b) In general dog parks should be between 1-2 acres in size; although smaller dog parks may be permissible in some cases.

c) Dog parks should be on flat terrain and if graded, to a general slope of less than 2.5%.

d) Dog parks must have a water source for months between April and November.

e) Dog parks should be ADA accessible.

f) In general dog parks should be split into two sections. One section should be for only smaller dogs' 25 lbs. or smaller. The second area can be for any size dog.

g) Site dog parks out of swales, steep slopes, streams and beaches.

h) Provide vegetated buffers of prescribed widths between dog parks and waterways, swales, storm drain inlets, gulley's and steep slopes.

i) Add pooper scooper stations with free sanitary "pick-up" bags and proper receptacles.

2) Fencing

a) All fencing must be at least 5 feet high.

b) Chain link fencing posts must be installed with at least 40 weight pipe.

c) All chain link fence fabric must be vinyl coated with a minimum 9 gauge core and 8 gauge finish fuse bonding. All fabric needs to be "Knuckle-Knuckle" for safety reasons. “Extruded” fabric is not permitted.

d) Entry areas should have a double gate system to prevent dogs from escaping.

e) All fence fabric and gates should be installed without gaps in order to prevent dogs from escaping. Gaps can be no more than 2 inches.

Chapter 10
Construction and Post Construction

10.1 STREET CONSTRUCTION

Work Zone Traffic Control

The developer is responsible for notifying the Public Works/Traffic Engineering Division, Emergency Medical Services, Police and Fire Departments, and residents of the area prior to implementation of work zone traffic control for a public street. Street closings are not allowed unless approved by the Town Manager. Lane closings are allowed only from 9:00 am to 4:00 pm on weekdays with the approval from the Town Public Works/Traffic Engineering Department. Work in the public right-of-way other than between 9:00 am and 4:00 pm weekdays is subject to approval by the Town Manager.

All work zone traffic control devices and procedures shall conform to the requirements of the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD), and the current edition of the North Carolina Department of Transportation (NCDOT) Supplement to the MUTCD for Streets and Highways, the NCDOT Roadway Drawings and the current edition of the NCDOT Standard Specifications for Roads and Structures.

Groundcover within Right-Of-Way

All disturbed areas within the right-of-way, including medians, shall have groundcover established in accordance with Town specifications. Groundcover shall be installed in all rights-of-way at a time determined by the Town Manager, providing however, it shall be installed and established prior to the release of the improvement bond.

Soil tests shall be submitted to the North Carolina Department of Agriculture by the contractor for all seeding, lime, and fertilizer requirements, unless this requirement is waived by the Town Manager. The contractor shall lime and fertilize according to the test results. Tall Fescue Kentucky 31 is acceptable, with 99% minimum purity and 85% minimum germination. Planting type and rates shall be per North Carolina Department of Transportation standard specifications.

All groundcover shall be maintained in accordance with North Carolina Department of Transportation specifications and shall be kept at a height no greater than six (6) inches (except on embankments) until the roadway has been accepted by the Town Manager and the performance bond has been released.

Use of Steel Plates in Roadways during Construction

Subject to written approval from Engineering, when backfill operations of an excavation in the traveled way, whether transverse or longitudinal, cannot be properly completed within a work day, steel plate-bridging will be required to preserve unobstructed traffic flow in Town streets and roadways. In such instances the following applies:

<u>Steel Plates Requirements</u>

- Steel plates must be able to withstand H-20 traffic loading without any movement.
- Steel plates shall be fabricated to meet ASTM A36 steel requirements,
- When two or more plates are used, the plate shall be tack-welded together at each corner to reduce or eliminate vertical movement. Alternative methods to accomplish this, such as metal connectors, will be considered for approval on a case-by-case basis.
- Steel plates shall be installed to resist bending, vibrations, etc., under traffic loads and shall be anchored securely to prevent movement. If these conditions are not met, the applicant will be required to backfill and pave the excavation daily, or use alternative methods such as “Plate Locks” which are designed to secure the plates with minimum noise and vibration.

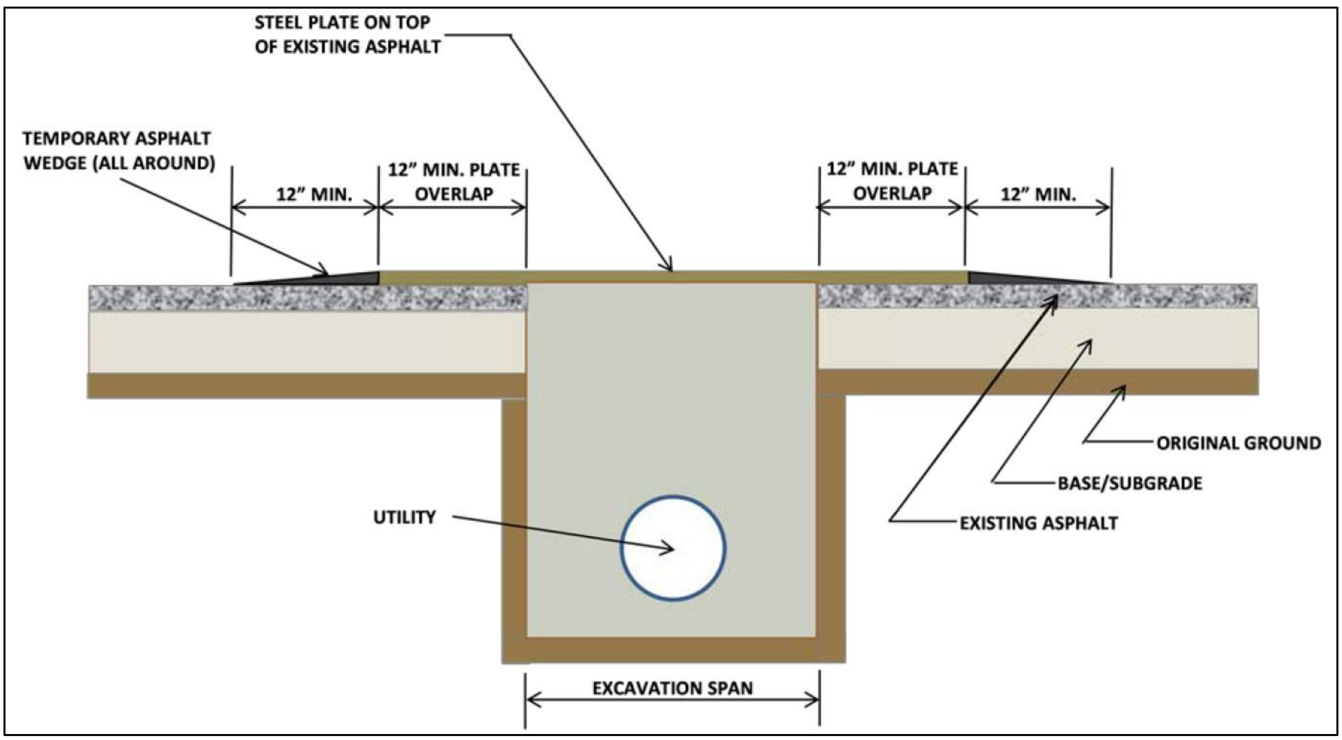
- All steel plates shall be property marked with the utility and contractor name, after-hours contact phone number in the event the plates need to be secured.
- All steel plates within the right-of-way, whether used in or out of the traveled way, shall be without deformation. The plate surface must not deviate more than ¼ inch when measured with a 10-foot straight edge along the length of the plate.
- It is the responsibility of the permittee to perform and document daily inspections of all active plate(s) or unattended plate(s) location(s), and where necessary take appropriate measures to protect the public safety until work is completed. This documentation shall be available to the Town inspector upon request. No un-plated excavation shall be left unattended overnight.
- In the event the improper installation of steel plates presents a nuisance or a public safety problem, the permittee shall respond to all excavation restoration requests by the Town immediately upon notification.
- Steel plates must extend a minimum of 12-inches beyond the edges of the excavation.
- Before steel plates are installed, the excavation shall be adequately shored to support the bridging and traffic loads.
- Temporary paving with a cold asphalt mix should be used to feather the edges of the plate to form a wedged taper to cover the edges of the steel plate. Other alternative methods to accomplish this will be considered for approval.
- Wedges or other non-asphaltic devices shall be used for leveling as required to eliminate rocking of the plates. Compacted temporary asphalt shall be used to fill all gaps between the plates and existing pavement surfaces.
- The use of steel plate in state maintained streets is subject to approval and inspection by the North Carolina Department of Transportation.

Steel Plate Installation:
Steel plate placement on traverse and longitudinal excavations shall be in accordance with the following:

Steel Plate Installation	Street/Road Type	Posted Speed Limit	Steel Plate Thickness
TYPE 1	Urban/Residential	35 MPH or Less	1-inch minimum
TYPE 2	Arterial/Collector	Greater than 35 MPH	1-1/4-inch minimum

Type 1 Installation
Type 1 installation shown in Figure 10.1, shall be used in areas where backfilling operations of an excavation in the traveled way, whether traverse or longitudinal cannot be properly completed within the same day, and the posted speed limit is 35 MPH or less. The steel plate shall be anchored securely to prevent movement. Temporary paving with a cold asphalt mix, or approved equal, should also be used to feather the edges of the plate to form a wedged taper to cover the edges of the steel plate.

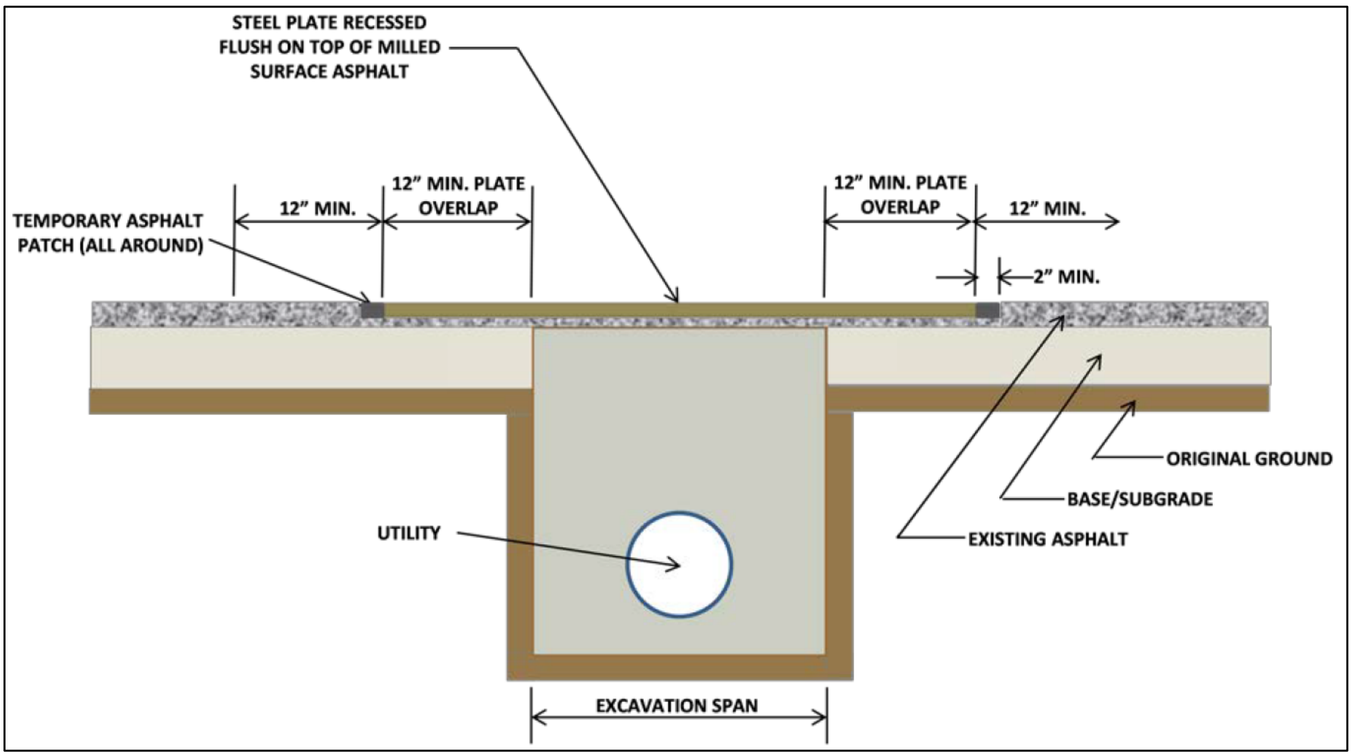
Figure 10.1 Type 1 Installation Detail



Type 2 Installation

Type 2 installation shown in Figure 10.2, shall be used in areas where backfilling operations of an excavation in the traveled way, whether traverse or longitudinal cannot be properly completed within the same day and the posted speed limit is greater than 35 MPH. The steel plate for Type 2 installations shall be recessed by milling into the existing asphalt to set flush with the surface of the existing asphalt. The pavement shall be cut and cold planed to a depth equal to the thickness of the plate and to a width and length equal to the dimensions of the plate. Full depth cutting of the asphalt section of excavation is not allowed. The steel plate shall be anchored securely to prevent movement. The gap between the edge of the plate and the adjacent existing asphalt pavement must be filled with temporary asphalt patch (cold mix). Wedges or other non-asphaltic devices shall be used for leveling as required to eliminate rocking of the plates. Compacted temporary asphalt shall be used to fill all gaps between the plates and existing pavement surfaces.

Figure 10.2 - Type 2 Installation Detail



10.2 STREET REPAIRS

Applicability

These standards apply to anyone cutting and excavating the Town of Chapel Hill streets, regardless of the reason for the cut and excavation. The standards apply to private and public utilities and contractors as well as the Town of Chapel Hill. These standards are not intended to supersede more substantial repair or resurfacing requirements on projects where specified repairs are shown on approved construction drawings or otherwise directed by Public Works.

General Requirements

Street cuts cause damage which reduce the level of service of the street on which they are made. In general, the repair standard will be what is termed a “T-patch”, which includes flow compatible fill and a minimum bench (or key) of 12 inches beyond the edges of the excavation. This 12-inch bench will define the width of the required surface repair (if applicable) measured parallel to the travel direction of the street. The length of the surface repair (if applicable) measured perpendicular to the street will be at a minimum the full width of a travel lane (from curb or edge of pavement to the crown or edge of travel lane). If the edge of the excavation crosses or is less than 2 feet from the crown or edge of travel lane, the surface repair must extend to the full width of the street or edge of the next travel lane. The cost of all repairs shall be borne by the party cutting the streets.

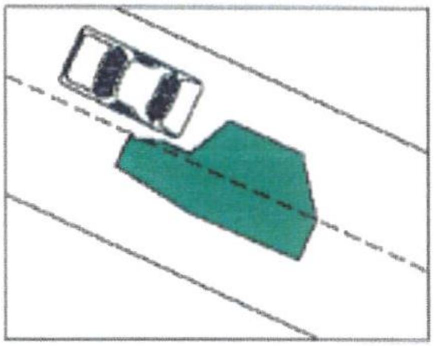
The full resurfacing area requirements specified herein shall apply to the Town streets with Institute for Transportation Research and Education (ITRE) pavement condition ratings (PCI) of 50 or higher. The full-depth structural repair is required on all Town streets.

Resurfacing requirements could possibly be reduced or increased, at the Town Public Works Department’s discretion, in situations where extenuating circumstances exist such as pending resurfacing or road widening projects, safety and traffic flow issues, speed humps, adjacent pavement features or the condition of adjacent pavement.

The examples on the following pages (adopted from Nashville, TN and Durham, NC) of utility cut repair details show repair methods not acceptable and the corresponding acceptable method.

Example 1: Existing pavements should be removed to clean, straight lines parallel and perpendicular to the flow of traffic. Do not construct patches with angled sides and irregular shapes. All repairs should be full lane width.

Not Acceptable



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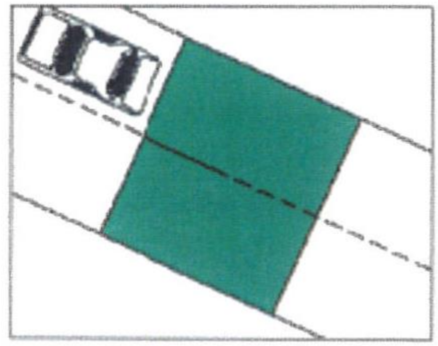
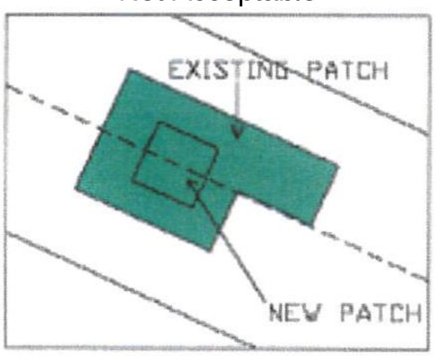


Example 2: Avoid patches within existing patches. If this cannot be avoided, make the boundaries of the patches coincide. All repairs should be full lane width.

Not Acceptable



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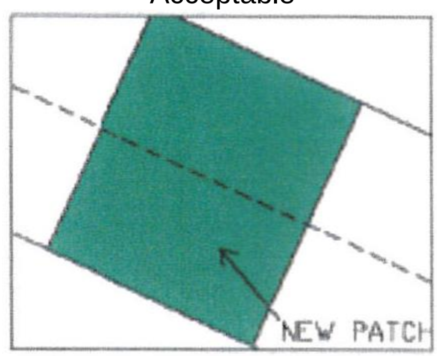
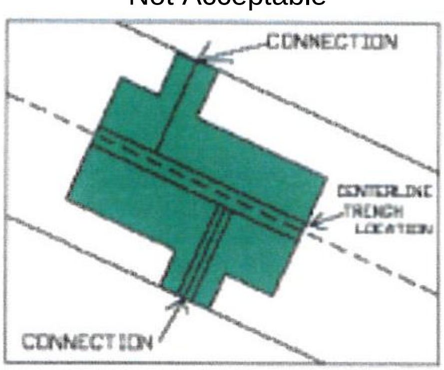


Example 3: For patches in asphalt, a tack coat shall be applied to all edges of the existing asphalt before placing the new pavement. After placing the new asphalt, all seams (joints) between the new and existing pavements shall be sealed with an asphalt tack coat or rubberized crack seal material. Avoid frequent changes in width of patches. For future maintenance, this simplifies removal of adjacent pavement failures.

Not Acceptable



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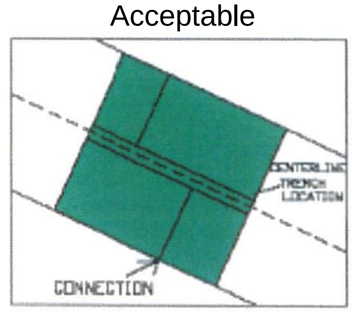
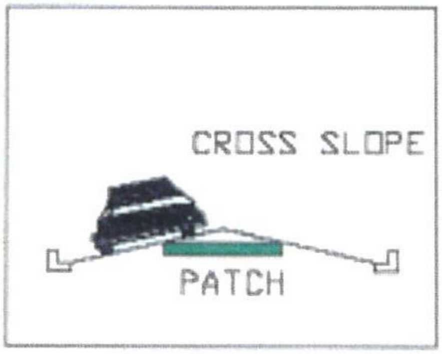


NOTE – TRENCH AND CONNECTOR LOCATIONS ARE CONCEPTUAL ONLY. SEE DETAILED CROSSECTION AND PROFILE SHEETS FOR CONSTRUCTION PROCEDURES AND WIDTHS.

Example 4: Patches should have a smooth longitudinal grade consistent with the existing roadway. Patches should also have a cross slope or cross section consistent with the design of the existing roadway.

Not Acceptable



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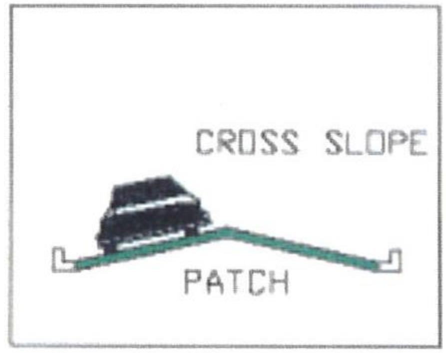
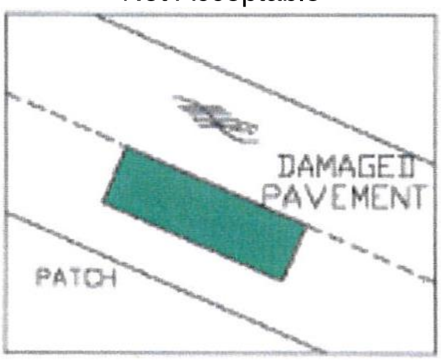


Example 5: When the proposed excavation falls within ten feet of a section of pavement damaged during the utility repair, the failed area shall be removed to sound pavement and patched. Scarring, gouging, or other damaged pavement adjacent to a patch shall be removed and the pavement repaired to the satisfaction of the engineering and public works divisions.

Not Acceptable



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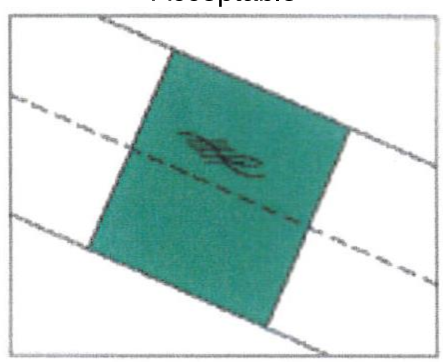
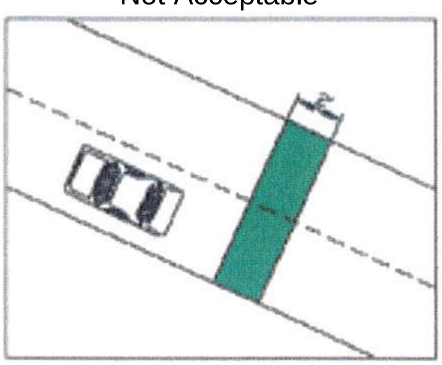


Example 6: Transverse patches on arterial and collector streets shall be overlaid across the entire street width for a distance of two (2) feet minimum on all sides of the trench using T-Patch.

Not Acceptable



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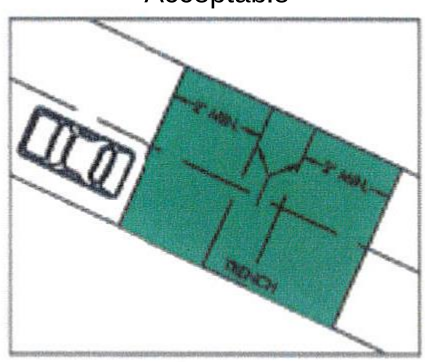
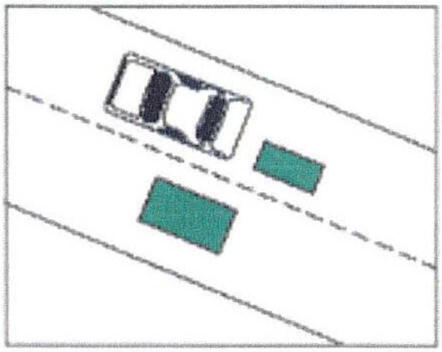


Example 7: Do not allow the edges of patches to fall in existing wheel paths. The edges of patches parallel to the direction of traffic shall be limited to the boundaries of lanes or to the centerline of travel lanes.

Not Acceptable



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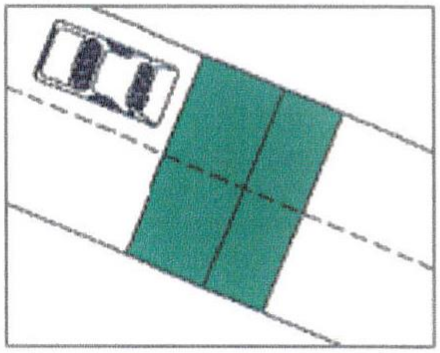
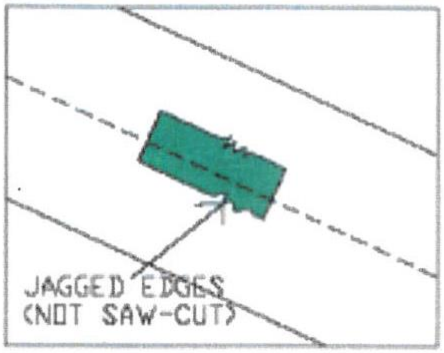


Example 8: Asphalt and concrete pavements should be removed by saw cutting or grinding. Avoid breaking away the edges of the existing pavement or damaging the remaining pavement with heavy construction equipment.

Not Acceptable



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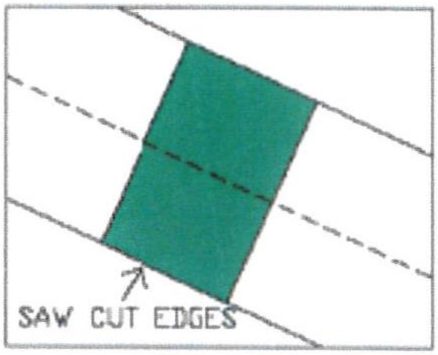
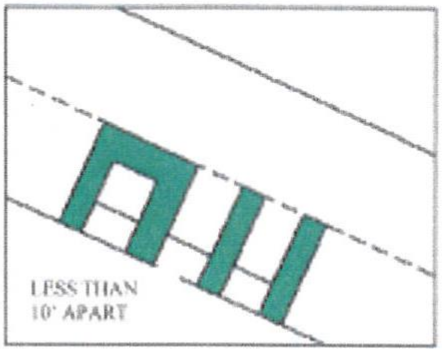


Example 9: In the case of a series of patches or patches for service lines off a main trench, repair the pavement over the patches by grinding and overlay when the spacing between the patches is less than 10 feet.

Not Acceptable



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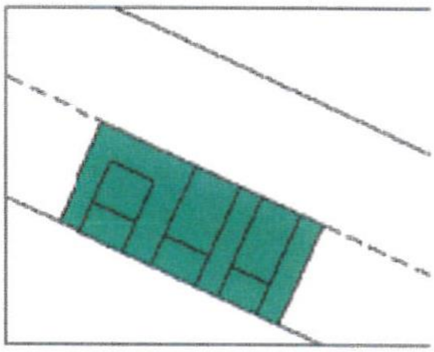
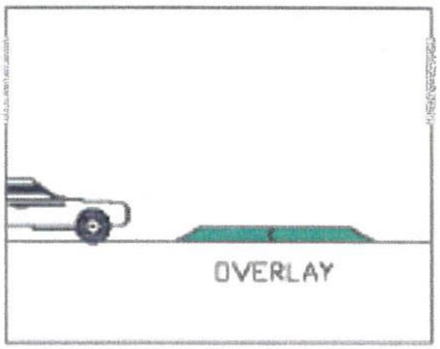


Example 10: Completed street repairs should have a ride ability at least as good as, if not better than, the pavement prior to the repairs. A driver may be able to see a street repair, but in the case of a quality repair, should not be able to “feel” it in normal driving. A patch should provide a smooth ride with transitions on and off the repair and all joints should be located outside the wheel path. Overlays should be placed by first removing the existing pavement to the desired depth by grinding or milling, and then placing the pavement flush with the adjacent surfaces. Overlays with feathered edges are not acceptable.

Not Acceptable



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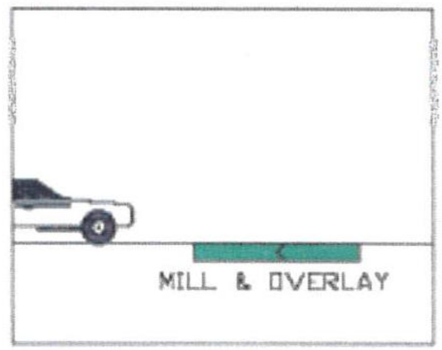
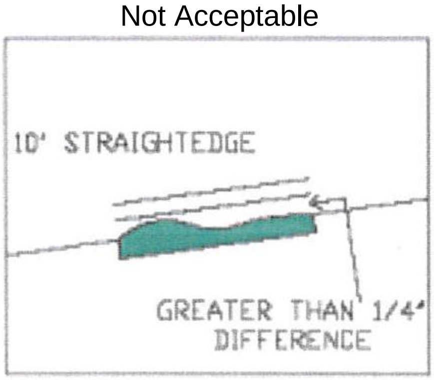


Example 11: Surface tolerances for street repairs should meet the standard for new construction. The finished surface of the street repair should be tested with a ten (10) foot straightedge parallel to the centerline or perpendicular across joints. Variations measured from the testing face of the straightedge to the surface of the street repair should not exceed on-quarter (1/4) inch.

Not Acceptable



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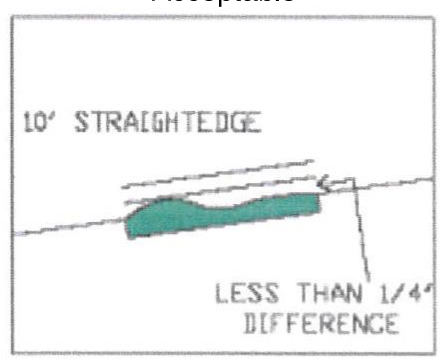

Street Construction Specifications

Unless stated otherwise in this manual all work in the Town and NC DOT right-of-way must follow NC DOT standard drawings and specifications.

10.3 PERMITS AND FINAL PLANS

STEP #1: Get your plans approved

ZONING COMPLIANCE/FINAL PLAN SUBMITTAL

The initial step for approval of Final Plans is to submit a Final Plan Application to the Permit Center in the Town of Chapel Hill Planning and Sustainability Department, 405 Martin Luther King, Jr Boulevard, Chapel Hill, NC 27514.

The link to the application web page is provided below, along with a comprehensive list of submittal requirements. Please note that some of the listed submittal requirements may not be applicable to every project. However, it is the responsibility of the applicant to ensure that all required submittals are provided with the initial application. An incomplete submittal will not be accepted. The applicant is advised to contact the Permit Center prior to filing the application.

The Final Plan Application for Zoning Compliance (ZCP) can be found here: http://www.townofchapelhill.org/town-hall/departments-services/planning-and-sustainability/development/development-application-forms.

ZONING COMPLIANCE PERMIT/FINAL PLAN SUBMITTAL REQUIREMENTS

The applicant shall submit all requirements and sections of the Final Plan Application. These are the minimum requirements for any submittal in order for the applicant to receive a complete review. In general, the minimum plans and design information required will include stormwater impact statement, cover sheet with area map, existing conditions plan, detailed site plan, roadway design plan, traffic plans, street light plan/streetscape plan, stormwater management plan, landscape protection plan, steep slope plan, grading and erosion control plan, planting plan, streetscape plan, phasing plan, solid waste plan, fire protection & utility plan, and transportation management plan. The minimum requirements for each plan are listed on the application.

Project Information:

Development Name:		Phase:
Owner:	Phone:	Email:
Contact Person:	Phone:	Email:

General Requirements

___1. Cover letter
___2. Attach Planning approvals for rezoning, subdivision, special use, etc. to the plans.
___3. Appropriate checklist completed and attached

General Information Required on All Plans

___1. Development Name
___2. Owner(s) Name(s) & Contact Information
___3. Preparer Name & Contact Information
___4. Graphic Scale, Date & North Arrow
___5. Property Boundaries w/ Bearings & Distances
___6. Adjoining Property Owners w/ Tax Pin Numbers & Zoning Information
___7. Adjoining Roadways w/ Right-of-Way Dimensions
___8. Current Zoning (and Proposed Zoning if applicable)
___9. Total Site Acreage
___10. Existing Easements & Building Setback Limits shown
___11. Proposed Easements, ROW, Common Areas, Areas Dedicated to Public Use
___12. Building Footprints w/ Square Footages & Finished Floor Elevations
___13. Limits of 100 Year Floodplain where applicable
___14. Location of Existing Structures

Cover Sheet/Area Map

1) Include Project Name, Project fact information, PIN, Design team
2) Area Map including:

    a) Project name, applicant, contact information, location, PIN, & legend
    b) Dedicated open space, parks, greenways
    c) Overlay Districts, if applicable
    d) Property lines, zoning district boundaries, land uses, project names of site and surrounding properties, significant buildings, corporate limit lines
    e) Existing roads (public & private), rights-of-way, sidewalks, driveways, vehicular parking areas, bicycle parking, handicapped parking, street names.
    f) Phasing Plan if required

Existing Conditions Plan

a. Slopes, soils, environmental constraints, existing vegetation, and any existing land features
b. Location of all existing structures and uses
c. Existing property line and right-of-way lines
d. Existing utilities & easements including location & sizes of water, sewer, electrical, & drainage lines
e. Nearest fire hydrants
f. Nearest bus shelters and transit facilities
g. Existing topography at minimum 2-foot intervals and finished grade

h. Natural drainage features & water bodies, floodways, floodplain, RCD, Jordan Buffers & Watershed boundaries

Detailed Site Plan

a. Existing and proposed building locations
b. Description & analysis of adjacent land uses, roads, topography, soils, drainage patterns, environmental constraints, features, existing vegetation, vistas (on & off-site)
c. Location, arrangement, & dimension of vehicular parking, width of aisles and bays, angle of parking, number of spaces, handicapped parking, bicycle parking . Typical pavement sections & surface type
d. Location of existing and proposed fire hydrants
e. Location and dimension of all vehicle entrances, exits, and drives
f. Dimensioned street cross-sections and rights-of-way widths
g. Pavement and curb & gutter construction details
h. Dimensioned sidewalk and tree lawn cross-sections
i. Proposed transit improvements including bus pull-off and/or bus shelter
j. Required buffers (or proposed alternate buffers)
k. Required recreation area/space (including written statement of recreation plans)
l. Refuse collection facilities (existing and proposed) or shared dumpster agreement
m. Construction parking, staging, storage area, and construction trailer location

Roadway Design Plan

a. Horizontal alignment with curve data (if applicable)
b. Vertical alignment (profile, curve length, grades, k-values, PVI stations)
c. Typical street cross-section
d. Cut and fill limits on topography
e. Intersection curb radii
f. Driveway locations and widths
g. Sight distance triangles at intersections
h. Geotechnical analysis (if applicable)
i. Right-of-way widths
j. Easements
k. Drainage facilities (materials used, slopes, invert elevations, HGL, spread/intercepted flow, pipe & channel size calculations for 10 and 25-year storm, pertinent off-site drainage features
l. Work zone traffic control plan
m. Pavement removals/demolitions

Traffic Plan

a. Traffic Calming Plan – detailed construction designs of devices proposed & associated sign & marking plan
b. Traffic Sign, Street Name Sign, and Pavement Marking Plan – in accordance with Manual on Uniform Traffic Control Devices. Street name signs in accordance with

Town of Chapel Hill standards

c. Traffic Signal Plan – in accordance with Manual on Uniform Traffic Control Devices and NCDOT traffic signal design standards (prepared by licensed professional engineer)

Street Lighting Plan/Streetscape Plan

a. In accordance with Town of Chapel Hill and Duke Energy standards; sealed by professional engineer
b. Proposed location of street lights and underground utility lines and/or conduit lines to be installed
c. Description and/or detail of proposed light poles, fixture, watts, lumens, and spacing
d. Other improvements, such as benches or bus stops, if proposed within public right-of-way
e. If Downtown Streetscape area, utilize standard downtown conduit detail
f. Location of street edge of pavement and/or curb and gutter, sidewalk, & property lines

Stormwater Management Plan

a. Topography (2-foot contours)
b. Existing drainage conditions
c. RCD and Jordan Riparian Buffer delineation and boundary (perennial & intermittent streams, note ephemeral streams on site)
d. Proposed drainage and stormwater conditions
e. Drainage conveyance system (piping)
f. Roof drains
g. Easements
h. BMP plans, dimensions, details, and cross-sections
i. Planting and stabilization plans and specifications

Landscape Protection Plan

a. Rare, specimen, and significant tree survey within 50 feet of construction area
b. Rare and specimen tree critical root zones
c. Rare and specimen trees proposed to be removed
d. Certified arborist tree evaluation, if applicable
e. Significant tree stand survey
f. Clearing limit line
g. Proposed tree protection /silt fence location
h. Pre-construction/demolition conference note
i. Detailed tree protection fencing
j. Landscape protection supervisor note
k. Existing and proposed tree canopy calculations, if applicable

Steep Slopes Plan

a. Classify and quantify slopes 0-10%, 10-15%, 15-25% and 25% and greater
b. Show and quantify areas of disturbance in each slope category

c. Provide/show specialized site design and construction techniques

Grading and Erosion Control Plan

a. Topography (2-foot contours)
b. Cut and Fill Lines
c. Cross-sections (Streets)
d. Detailed Drawings of infrastructure (BMPs, curb inlets, infiltration systems, erosion control, etc.)
e. Limits of Disturbance
f. Pertinent off-site drainage features
g. Existing and proposed impervious surface tallies
h. Ground cover
i. Spot elevations when necessary
j. Size calculations

Planting Plan

a. Dimensioned and labeled perimeter buffers
b. Landscape buffer and parking lot planting plan (including planting strip between parking and building, entryway planning)
c. Off-site buffer easement, if applicable
d. Detailed buffer planting plan
e. Detailed parking lot shading/screening plan
f. Detailed composite plant list with installation sizes
g. Landscape installation details and maintenance plan

Streetscape Plan (If Required)

a. Public right-of-way existing conditions plan
b. Streetscape demolition plan
c. Streetscape proposed improvement plan
d. Streetscape proposed utility plan and details
e. Streetscape proposed pavement/sidewalk details
f. Streetscape proposed furnishing details
g. Streetscape proposed lighting details

Solid Waste Plan

a. Solid Waste Management Plan approval by Orange County
b. Existing and proposed dumpster pads
c. Proposed dumpster pad layout design
d. Proposed dumpster pad construction section
e. Proposed dumpster pad protective bollard and screening fence details
f. Proposed heavy duty pavement locations and pavement construction detail
g. Existing pavement damage waiver note
h. Refuse facility lighting plan

Fire Protection and Utility Plan

a. Fire Flow Report: for a fire hydrant within 400 feet of each building, provide the calculated gallons per minute when residual pressure is 20 pounds per square inch. The calculations should be sealed by a licensed Professional Engineer in NC and accompanied by a water supply flow test conducted within one year of the submittal (see Utilities Chapter of Town of Chapel Hill Engineering Design Manual for required gallons per minute)
b. Indicate location and size of water, sewer, electric, cable, telephone, gas and fire safety apparatus

Transportation Management Plan

A Transportation Management Plan (TMP), for the development process, shall be approved by the Town Manager prior to issuance of Zoning Compliance Permit. This plan shall be updated annually and approved by the Town Manager

(1) Installation of a shower for use by any building employees utilizing alternative transportation
(2) Designated spaces will be provided for car poolers as well as alternative fuel vehicles.
(3) Designation of a Transportation Management Plan (TMP) Coordinator – name, title, email, phone, and address to be provided
    1. Regularly communicate and promote alternate modes of transportation, year round, to all those employed in the building.

    2. Attend the annual Go Chapel Hill TMP Conference to receive updates and training regarding TMP information distribution and application.

    3. Submit to the Town of Chapel Hill Planning an Occupancy Survey due 90 days after issuance of the final Certificate of Occupancy.

    4. Submit to the Town of Chapel Hill Planning Department an updated annual Transportation Management Plan Report.

    5. Conduct Employee and Resident surveys during survey years. Employee surveys will be distributed to each employee working in the building and then returned to the Town of Chapel Hill Planning Department by specified deadline.

    6. Will take steps to gradually attain the goals of the Go Chapel Hill TMP Program.

    7. Conduct annual survey of employees for any increased demand for additional bicycle parking and installation of those facilities on an as-needed basis, if determined to be appropriate by the Town Manager.

Stormwater Requirements

<u>Stormwater Management Report Requirements</u>

Pursuant to the Town of Chapel Hill Land Use Management Ordinance Section 5.4, Stormwater Management, all applications for developments or subdivisions and any building (some single-family or two-family dwellings resulting in less than or equal to 20,000 square feet of land disturbance may not be subject to these requirements) within the Town of Chapel Hill Planning Jurisdiction must include a Stormwater Management Report. As authorized by the Chapel Hill Land Use Management Ordinance, affirmative exemption to all or part of the requirements of the Stormwater Management Report may be granted by the Town.

a. Written narrative describing

    1. Existing & proposed conditions
    2. Pertinent onsite and offsite drainage conditions
    3. Anticipated stormwater impacts
    4. Design criteria
    5. Discussion of structural and non-structural SCMs and strategies chosen to mitigate development impacts that will be part of the stormwater management plan
    6. Soils information (classification, infiltration rates, depths to groundwater and bedrock)

b. Summary tables of the peak discharge flow rates (1, 2, and 25-year storms) for pre-development; post-development without stormwater management; and post-development with stormwater management, for *each* sub-basin/POA *and* the project site as a whole.

c. Summary table of the volume management results (WQV and 2-year storms) for pre-development; post-development without stormwater management; and post development with stormwater management, for all sub-basins/POAs and the project site as a whole.

d. Hydrology calculations, to include:

    1. Pre-development and post-development drainage maps clearly labeled and showing delineated drainage sub-basins; connectivity of conveyance system and stormwater structures; and POAs. Flow paths in each sub-basin must be indicated (may be included in plan set). Location of jurisdictional wetlands, streams and regulatory FEMA Special Flood Hazard Areas. Drainage area maps must be to scale; scale shall be no smaller than 1-inch = 100-feet. Maps must include 2-foot contours, at minimum.

    2. Summary table of land uses and areas (in square feet) within each drainage basin, curve numbers/runoff coefficients for each land use, Basin ID, and source of values used.

    3. Time of concentration (T_c) calculations

    4. Peak discharge calculations, with results documented in a summary table (See b. above).

    5. Volume management calculations, with results documented in a summary table (See c. above).

e. Hydraulic calculations, to include:

1. Water quality volume calculations for providing 85% TSS removal for post-development stormwater runoff

2. BMP sizing calculations, including stage-storage-discharge information

3. Routings and hydrographs for each sub-basin point of analysis

4. Pipe sizing calculations, pipe schedule and Hydraulic/Energy Grade Line (HGL/EGL) study (for all storm drainage pipe systems; the study shall include profiles with labeled inverts, slopes, proposed finished grade and hydraulic grade line for 10-year, 24-hour and 25-yr, 24-hour storm events)

5. Backwater elevations and effects on existing drainage conveyance facilities.

6. Channel sizing calculations

7. Outlet dissipater sizing calculations

f. Nutrient Loading Calculations – Completed output from Jordan/Falls Stormwater Load Accounting Tool printed on 11x17 paper.

g. Draft Inspections, Operations, and Maintenance Plan for each stormwater management structure.

ENGINEERING CONSTRUCTION PERMIT PLAN SUBMITTAL

An Engineering Construction Permit (ECP) is issued by the Engineering & Design Division for the installation of all non-franchised public infrastructure in existing or proposed public rights-of-way, and required stormwater management devices. Although it is typically issued in conjunction with a Zoning Compliance Permit, the applicant must have an ECP prior to beginning any work in the public right-of-way.

ENGINEERING CONSTRUCTION PERMIT PLAN DRAWING SUBMISSION REQUIREMENTS

The following list should be used by the applicant before any engineering design submittal so that applicants are aware of the minimum requirements. The checklists in this section are intended as a guide and may not be inclusive of all the required information. The Engineering Roadway Plan Checklist is a submittal requirement.

All plans that are submitted directly to the Town of Chapel Hill, Public Works/Engineering & Design Services Division shall be accompanied by a cover letter (or transmittal note) stating:

- Project Name
- Contact Person, Phone Number, Email Address
- Reason for Plan Submittal
- Planning Approvals, if applicable (Rezoning, Subdivision, Special Use, etc.)
- Appropriate Engineering Checklist(s)
- Engineering Review Fee (See Fee Schedule)

Note:

- All plan submittals must be stamped and sealed by the engineer and marked “For Construction” or “Preliminary”.
- Failure to identify the project and the reason it is being submitted may cause delay in the review process.

For first time submittal of construction drawings that require Engineering’s review for public infrastructure, submit a minimum of three (3) complete bound sets of prints and one (1) electronic PDF file. The plans are submitted to the Senior Engineering Coordinator in the Engineering & Design Services Division of the Public Works Department, 6850 Millhouse Road, Chapel Hill, NC.

*Submit drawings separately to the Orange Water & Sewer Authority if requiring a water and/or sewer plan review.

All drawings must have the following stamp of approval on each sheet.

Town of Chapel Hill
All Construction Methods and Materials shall be In accordance with the Town of Chapel Hill, Orange Water & Sewer Authority (OWASA), end NCDOT Standards and Specifications. In the event of a conflict between standards, the more stringent shall govern unless a waiver la issued by the Town Engineer and/or Authority Having Jurisdiction (AHJ). Utility installations and other Public Facilities, Including streets, sidewalks, stormwater, and handicap ramps, have been approved by the Town of Chapel Hill and shall be so installed unless a change is authorized by prior written approval. Public Water/Sanitary Sewer, Stormwater, and Utility Easements shall be recorded prior to final acceptance and/or issuance of a Certificate of Occupancy by the Town.
The Town of Chapel Hill may require redesign and/or reconstruction of work shown on the approved plans, subsequent to such approval, if it becomes evident that the design is inadequate to meet actual field conditions and/or is based on incomplete, insufficient, inaccurate, or misleading data portrayed on the approved plans. The Town of Chapel Hill accepts no responsibility for costs involved in such redesign end/or reconstruction.
Engineering Date:

Roadway Plans Check List

Coordination with approved site plan

___1. Verify Site plan hasn't changed
___2. Functional criteria for each street listed matches approved site plan
___3. Intersections match approved site plan
___4. Driveways match approved site plan
___5. Bike/Ped accommodations match approved site plan
___6. Traffic Management plans match approved site plan

Functional Criteria for every proposed street or connecting street

___1. Street classification
___2. Proposed speed limit
___3. Typical Cross-section

Horizontal Design

___1. Alignment shown and labeled on plan view
___2. Curve Data on plans

____3. Pavement width identified
____4. Tapers
____5. Guardrail (if applicable)
____6. Islands/Medians (with detailed drawing)

Vertical Design

____1. Roadway profile with centerline, and back of curb elevations for cul-de-sacs
____2. Vertical curve data on plans, with K values
____3. Grades
____4. Drainage pipe profiles shown

Storm Drainage

____1. Calculations with HGLs provided
____2. Table on plans
____3. All pipes and structures shown and labeled on plan & profile
____4. Drainage areas identified on plan view
____5. Gutter spread
____6. Ditch cross-sections

Utilities

____1. OWASA approval for water/sewer (prior to final plan approval)
____2. Water/sewer in approved cross-sectional corridor
____3. Utilities in approved cross-sectional corridor
____4. Minimum cover
____5. Street lights

Cross-Sections at 50 feet Stations

____1. Pavement width, depth and type
____2. Superelevation or normal crown
____3. Drainage ways
____4. Furniture/plant zone
____5. Bike/Ped accommodations
____6. ROW & Easements shown
____7. Utility corridors identified
____8. Cut/fill slopes

ROW & Easements

____1. ROW
____2. Utility Easements
____3. PDE
____4. Sight distance triangles
____5. Setbacks
____6. Buffers

Bridges and culverts

____1. Sealed Shop Drawings

Intersections

____1. Stop control
____2. Storage lengths
____3. Curb radii
____4. Pedestrian treatments
____5. Sight distance

Driveways

____1. Type
____2. Location
____3. Spacing
____4. Vertical profile or typical
____5. Width

Bike/Ped

____1. Sidewalks
____2. Pedestrian crossing
____3. Greenways

Parking

____1. On street-marked
____2. On street-unmarked
____3. Private Lot
____4. Private drives

Details

____1. Standard & Non-standard items

Traffic Control

____1. Signage
____2. Markings

Other

___1. Fire Hydrant locations
___2. Submittal of Fire Flow Calculations to Permit Center
___3. Submittal of Work Zone Traffic Control to Traffic Division

Once approved by all agencies involved, five (5) paper copies, two (2) digital copies (PDF and DWG) of approved drawings with "For Construction" stamped on the plans and all appropriate signatures must be submitted to the Senior Engineering Coordinator with Engineering and Design Services Division. Prints are logged in, reviewed, stamped "Approved for Construction", signed, and distributed as follows:

- One (1) paper copy on file in the Engineering Division
- One (1) paper copy for the Engineering Inspector
  One (1) paper copy for the Stormwater Division
  One (1) paper copy for the Stormwater Engineer
- One (1) paper copy will be returned to the submitting Engineer

The applicant should submit additional copies if needed for their own use.

Revisions to Approved Plans

- Any revisions (including any revised phasing) made to previously approved construction plans must be re-submitted through the review process for approval. However, proposed Field Changes for projects under construction may be submitted directly to the Senior Engineer and Senior Engineering Coordinator for expedited review.
- All revisions must be "hi-lighted" on all copies each time they are submitted.

STEP #2A: Get Your Permit to Construct

ENGINEERING CONSTRUCTION PERMIT

Copies of permit applications are available in Appendix A, or on-line at: http://www.townofchapelhill.org/home/showdocument?id=3166

TO GET AN ENGINEERING CONSTRUCTION PERMIT (ECP)

- Provide an itemized cost estimate with quantities and unit prices for all work in the public right-of-way, in addition to any town maintained trails, sidewalks, paths and other amenities outside of the right-of-way. If the improvements exceed $10,000 a surety bond, bank or saving and loan letter-of-credit, or cash must be provided to the Town. The bond amount will be 125 percent of the estimated cost.
- A Sediment and Erosion Control Bond is required for any land disturbance activity of one acre or more. The Bond amount is calculated at a pro rata rate of $5,000 per disturbed acre.
- The aforementioned bonds, when applicable, will be submitted along with the Engineering Construction Permit (ECP) for approval. The ECP requires a copy of the applicant's State Contractor's License for work exceeding $50,000, and a Certificate of Liability Insurance with the Town named as a certificate holder, in the amount of $1,000,000.
- Schedule a pre-construction conference with Town staff prior to any land disturbing activity.

In addition to the approved drawings the applicant must complete the Engineering Construction Permit with the required fees. The Contractor must provide the following:

1. Itemized Cost Estimate
2. Performance Bond (converted to Warranty Bond at completion)
3. S & E Bond
4. Copy of Contractor's License
5. Proof of Insurance
6. Pay the Permit Fee
7. Schedule Preconstruction Conference

After items 1 through 6 have been completed the contractor shall schedule a preconstruction conference with the Public Works/Engineering Division.

- During the construction process the contractor will ensure that Town required Engineering inspections are accommodated.
- Upon completion of the public infrastructure improvements, a Final Inspection will be

scheduled with the Engineering Inspector and the Stormwater Engineer.

- Upon satisfactory completion of the Final Inspection Punch-List, the developer/owner will provide the Town sealed as-built construction plans for the project, a Stormwater Maintenance Bond and Maintenance Manual as required, and a Public Improvements Warranty Bond in the amount of 25 percent of the original public improvements cost estimate, but not to exceed $50,000.
- If the project is located within the Town limits all public improvements will be accepted for maintenance by letter from the Public Works Department. Projects within the ETJ will receive a Letter of Completion.

Information on appropriate Building Permits can be found on the Planning and Inspection website. http://www.townofchapelhill.org/town-hall/departments-services/planning-and-sustainability/permits-and-inspections.

STEP #2B: Check to Ensure you have Permits from other Agencies

OTHER PERMITS

It is usually necessary to obtain permits/approvals from other entities prior to construction. It is the applicant's responsibility to obtain approvals from other Town departments and outside agencies.

General

New construction with in the Town or its ETJ may require the developer to obtain several different permits. Below is a list of permits that may be required along with the appropriate contacts and their contact information. If you are not sure if a permit is needed please contact the Public Works Department for assistance.

NCDOT Driveway Permit

Copies of the NC DOT driveway permit can be obtained on line at: http://www.ncdot.org at the district NC DOT offices in Graham, North Carolina.

For Orange County: NC DOT Division 7, District 1
Counties-Alamance, Orange
PO Box 766
127 East Crescent Square Dr.
Graham, NC 27253

Town of Chapel Hill Driveway Permit

All new and modified driveways accessing Town or NC DOT streets and road right-of-way are required to obtain driveway permits prior to installation. Any change of use on a property also requires approval of a driveway permit. For driveways onto NCDOT right-of-way, Public Works/Engineering Division must first sign the driveway permit before forwarding to NCDOT.

With the exception of single family residential driveways onto Town right-of-way, the driveway permit is approved as part of the Engineering plan approval process and no additional form is required. Standards for residential driveways can be found in Chapter 3.

For single family residential driveways, a copy of the Town's Driveway Permit Application is at Appendix A, or http://www.townofchapelhill.org/home/showdocument?id=3164

Contact: Town of Chapel Hill:
Public Works/Engineering Division
6850 Millhouse Road
Chapel Hill, NC 27516
919-969-5100

Encroachments in the Town Maintained Public Right-of-Way

An encroachment is an installation that is owned by an individual(s) or business entity within the street right-of-way. Generally, an encroachment agreement is required for all installations when a foundation or footing is necessary for the encroachment, any installation above or below grade that may inhibit the public use of the available space in the right-of-way or create potential maintenance difficulties for the Town. Some examples of encroachments are fences, walls, mail box on a foundation, significant landscaping, above ground communication boxes, aerial and underground cable, and private irrigation systems.

The Town Manager or Public Works Director may approve temporary encroachments after staff review to ensure the public's safety and welfare. To apply for an encroachment the requestor must contact the Engineering Division and provide a description of the proposed encroachment, plus a sketch showing the dimensions with the proposed location. If approved, the applicant must fill out the Encroachment Agreement and attach an 8 1\2 inch by 11 inch exhibit showing the installation and location. (See Appendix A for sample agreement) After all signatures the applicant is asked to record the agreement at the Register of Deeds and send a copy of the recorded document to the Engineering Division.

Contact: Town of Chapel Hill
Public Works/Engineering Division
6850 Millhouse Road
Chapel Hill, NC 27516
919-969-5100

Encroachment in NCDOT Maintained Public Right-of-way

A three party NC DOT encroachment agreement is required when any developer, contractor, utility company or other government agency proposes work of any nature, other than routine maintenance, in NC DOT's Right-Of-Way. Copies of the three party encroachment agreements are available on the NC DOT web site at: http://www.ncdot.gov .

Contact: NC DOT Division 7, District 1
Counties-Alamance, Orange
PO Box 766
127 East Crescent Square Dr.
Graham, NC 27253

Jordan Buffer Authorization

A stormwater/watershed permit is required for all development and redevelopment, unless exempt by the stormwater and watershed ordinances. The permit is intended to provide a mechanism for the review, approval, and inspection of the approach to be used for the management and control of stormwater for the development or redevelopment site consistent with the requirements of the stormwater and watershed ordinances, whether the approach consists of structural BMPs or other techniques such as low-impact or low-density design. A copy of the town's permit application is available on the Town's web site, or at:

Contact: Town of Chapel Hill
Stormwater Administrator
6850 Millhouse Road
Chapel Hill, NC 27516
919-969-5100

Stream Crossings or Wetlands Disturbance

Any development or redevelopment activity that proposes to cross or disturb any length of stream or disturb more than 0.1 (one-tenth) of an acre of wetlands may require a notification or a permit obtained though the U.S. Army Corps of Engineers, and the NC DEQ Division of Water Resources (DWR) 401 permitting unit. Stream determinations in the Town of Chapel Hill are made by the town's Stormwater Administrator. For more information on these permit requirements contact the Town's Stormwater Administrator.

Contact: Town of Chapel Hill
Stormwater Administrator
6850 Millhouse Road
Chapel Hill, NC 27516
919-969-5100

Water and Sewer Permits

Any development or redevelopment that requires a new or upgraded connection to public or private water and sewer systems will require a water and/or sewer permit. These permits are obtained through Orange County Water and Sewer Authority (OWASA). The requirements for submission including the required project fact sheet can be found at: https://www.owasa.org/development-project-documents-and-forms.

Contact: OWASA
Plans Review Coordinator
400 Jones Ferry Road
Carrboro, NC 27510
919-968-4421

Sediment and Erosion Control

All projects which disturb more than 20,000 SF within the Town of Chapel Hill and its Extraterritorial Jurisdictional (ETJ), including areas of Durham County within the Town limits, must have an approved Erosion and Sedimentation Control Permit from either Orange County or NC DEQ. Information on Orange County, including required forms and checklist can be found at:

http://www.orangecountync.gov/departments/planning_and_inspections/erosion_control.php. Copies of the required forms and checklist can be found at: http://portal.ncdenr.org/web/lr/forms, or by contracting the Orange County or NC DEMLR

Contact: Orange County
Planning and Inspections
West Campus Office Building
131 West Margaret Lane
Hillsborough, NC 27278
919-245-257

Contact: NC DEQ Raleigh Regional Office
3800 Barrett Drive
Raleigh, NC 27609
919-791-4200

Building Permits

The Inspections Division, as a part of the Office of Planning and Sustainability, manages the inspections and permits. The main responsibilities of the Division include:

- Enforcement of the NC State Building Codes, Chapel Hill Code of Ordinances, Minimum Housing Code, and the Land Use Management Ordinance.
- Resolution associated complaints, public requests for assistance, issuing sign installation permits, inspecting day care facilities, and inspecting business occupancies.

Additional information on obtaining a building permit can be found on the Inspections Division's web site: http://www.townofchapelhill.org/town-hall/departments-services/planning-and-sustainability/permits-and-inspections.

For more information about online permitting services, please visit the Town's Online Permitting Services webpage. http://www.townofchapelhill.org/town-hall/departments-services/planning-and-sustainability/permits-and-inspections/online-permitting-services.

Contact: Town of Chapel Hill
Planning and Inspections
First Floor, Town Hall
405 Martin Luther King Jr. Blvd.
Chapel Hill, NC 27514
919-968-2718

Tree Work Permits

Section 5.7 of the LUMO requires a Tree Work Permit for any tree removal within the Town Limits. An example of a Tree Removal Request can be found on the Town's web site. The following information at a minimum must be provided:

- Property Owner
- Tree Location

- Tree Description
- Reason for Removal
- Removal Method
- Maps, aerial imagery, and pictures are also helpful.

Tree removals shall be carried out in a manner that minimizes damage to existing vegetation that is to be retained. Tree protection fencing shall be installed along the adjacent property line within the limits of work and inspected prior to the start of any activity authorized by the Tree Work Permit. As per the written permit request, no heavy equipment is allowed over/on critical root zones of rare and specimen trees to remain (see Section 5.7 of the Land Use Management Ordinance).

The stump and root mat shall remain in place to minimize damage to roots of adjacent trees to remain. The stump may be cut flush and/or ground.

Work shall be contained on the subject property, including disposal of debris and wood chips. No access to adjacent property is authorized by this permit and is subject to permission of the adjacent property owner.

Contact: Town of Chapel Hill
Public Works/Engineering Division
6850 Millhouse Road
Chapel Hill, NC 27516
919-969-5100

All properties except single/two family residential require a Tree Work Permit. Submit site plan with the location of the tree(s) and the reason for removal in writing with signature of the property owner. If the tree removal is tied to a landscape requirement replacement of the tree may be required. Please flag the tree(s) for review in the field.

Step #3 – Build Your Project

CONSTRUCTION/INSPECTION STANDARDS

General

- Failure to adhere to these preliminary requirements as well as the requirements contained in this section titled CONSTRUCTION/INSPECTION STANDARDS would constitute justification for an immediate issuance of a "Stop Work Order" from Engineering.
- Refer to the Stormwater Chapter of this manual for inspections on Stormwater BMPs.

Coordinating Site Construction with Town Engineering

1. It should be restated that any construction activity authorized by construction plan approval cannot take place until all of the regulatory approvals required by law, but not necessarily limited to the Town of Chapel Hill, Orange County, North Carolina Department of Transportation, North Carolina Department of Environment and Natural Resources, and US Army Corps of Engineers, are received. Copies of all the required corresponding approvals must be provided to the Town.
2. No change can be made to the construction plans or in the field unless the Town of Chapel Hill Public Works/Engineering Department is notified, and reviews and approves the change prior to initiating construction.
3. A pre-construction meeting must be scheduled with the Town's engineering inspectors prior to the start of construction to ensure that the scope of work and the corresponding method of construction and testing are acceptable and noting when site inspections are required to be conducted by Town staff. At a minimum, engineering inspections must be scheduled and coordinated during the following construction stages:
    a. Verification of tree protection fence
    b. Temporary traffic control
    c. Placement of fill
    d. Road subgrade
    e. Curb and gutter alignment
    f. Curb and gutter installation
    g. Road paving
    h. Sidewalk forms (includes driveway aprons)
    i. Sidewalks and driveway aprons
    j. Retaining walls
    k. Drainage pipes and other structures before backfilling
    l. Stormwater management facilities
    m. Street name signs
    n. Traffic control signs and pavement markings
4. The Certificate of Occupancy shall not be issued until all on-site and off-site improvements in the applicable phase are constructed and accepted by the approving authority. Please be advised that to attain a final Certificate of Occupancy from the Town of Chapel Hill all Town Departments performing inspections must sign-off to release the project.

General Construction Requirements

- Each phase of the work will be satisfactorily completed as shown on the "Approved" plans before the next phase will be allowed to begin, except those items of work that may be performed concurrently, or as consistent with the approved phasing plan.

- All construction tolerances and materials will conform to NC DOT standard drawings and specifications or as may be included in this manual.

- Should construction be discontinued during the winter, the entire project will be re-evaluated in the spring. All necessary corrections to prior work will be made at that time and the project can proceed to the next phase.

- For privately maintained infrastructure: Following the completion of all work items, the developer and/or their engineer will inspect privately owned infrastructure for compliance with the construction drawings and provide the appropriate certifications.

- For publicly maintained infrastructure: After the developer and/or their engineer have inspected the development and verified that any needed corrections have been made, the Public Works/Engineering Division shall be contacted to schedule the applicable inspection. If the project is not accepted, the Public Works/Engineering Division will provide the developer or their representative with a checklist of corrections (punch list).

- For public infrastructure,once a final inspection has been conducted and the work approved, the developer will be required to provide a one (1) year warranty bond on all roadway and storm drainage improvements. The bond amount shall be 25 percent of the cost of construction but not greater than $50,000 The Developer and/or Engineer shall submit “As-Builts” and “Final Plat” both in hard copy (1) and electronically (one disc).

Construction Procedures for Town Inspected Projects

Beginning Construction:

- Hold a preconstruction meeting with the Town’s Engineering and Public Works Department after final plans have been approved, and prior to the start of construction.

- An erosion control permit must be obtained from the Orange County prior to any land disturbing activities over one 20,000 sf in size. Erosion Control and DWQ permits must be obtained as site conditions necessitate.

- Contractors shall have "Approved" plans on the job site while any work is being performed.

- Any work done without proper inspection will be subject to being uncovered or removed as required to fully verify compliance with the "Approved" plans, specifications, and proper construction practices.

Construction Sequence:

- The Public Works/Engineering Division has the responsibility to control to determine the acceptability of construction operations relative to recognized standards and specifications. Unless specifically approved by the Public Works/Engineering Division, the construction sequence should follow Table 10.1 below. The Town's Inspector will check items listed under Town's Inspector as the work progresses. An inspection is **REQUIRED** under items listed under the Inspection required column before the next step of construction can proceed.

TALBLE 10.1 Construction Sequence Guideline for Town Maintained Construction

#	Inspection Activity	Town's Inspector	Inspection Required
1	Conduct Preconstruction Conference	X	
2	Obtain all Permits, Encroachment, Erosion, etc.	X	
3	Have an approved final set of plans	X	
4	Stake the clearing limits		
5	Stake and install all of the erosion control devices possible prior to grubbing	X	
6	Clear and grub the site	X	
7	Stake and install the remaining erosion control devices	X	
8	Slope stake		
9	Rough grade within R/W and utility easements	X	X
10	Temp. seeding and mulching shall be performed as needed to meet the erosion control permit requirements	X	
11	Density testing as needed	X	
12	Stake and install the storm drainage and sewer mains and services. All services to be outside of the sidewalk limits	X	X
13	Install erosion control devices around storm drain structures	X	
14	Stake and install all water mains and services. All services to be outside of the sidewalk limits		
15	Stake and install the utility conduits lines		
16	Density testing as needed on trench lines, specifically within R/W	X	
17	Sub-grade fine grading	X	
18	Sub-grade, proof roll and density testing as needed	X	X
19	First lift of ABC placement	X	
20	Staking and placement of C & G	X	X
21	Backfill of C & G	X	
22	Completion of ABC placement, fine grading and setting up of the ABC	X	
23	Proof roll and grade check of ABC, density testing as needed	X	X
24	Placement of Intermediate course asphalt	X	X
25	Shoulder and utility easements to be close to final grade +/- 0.1	X	

26	Install utility lines within the utility easements	X	
27	Street light installation	X	
28	Grade and place sidewalks	X	X
29	Finish dressing up shoulders and utility easements	X	
30	Placement of surface course asphalt	X	X
31	Core samples collected on Roadway	X	
32	Installation of pavement markings if required	X	
33	Final seeding of R/W and utility easements	X	
34	Final Inspection conducted and certifications submitted	X	X

Notification for Inspections:

- It is the responsibility of the contractor to notify the Public Works/Engineering Division **before each work phase begins**. Failure to notify the Public Works/Engineering Division for an inspection may result in the need to uncover completed work. The Town reserves the right to deny final acceptance of streets and storm drainage systems where developers failed to construct as per the standards in this manual and/or fail to make repairs as directed by the Inspector. Notification should be made two (2) days in advance.

- For an inspection, call the Public Works/Engineering Services Division to schedule an inspection.

- For Stormwater BMP inspections refer to Chapter 4 of this Manual.

<u>Schedule of Inspections</u>
Required Inspections:

<u>Rough Grade Inspections</u> - Periodic rough grade inspections will be conducted by the Inspector. The developer/owner shall immediately notify the Public Works/Engineering Division upon discovery of unsuitable soils such as, alluvial material, gumbo, underground springs, old fill material such as stumps, trees, top soil, trash, etc.

<u>Storm Drainage Inspections</u> - Periodic storm drainage installation inspections will be conducted by the Inspector to insure approved materials are being used and the installation conforms to the standards found in this manual and the NCDOT Standard Specifications. The developer/owner shall notify the Public Works/Engineering Division before storm drainage work is scheduled to begin.

<u>Subgrade Proof Roll</u> - Forty-eight (48) hours prior to base placement, the subgrade shall be proof rolled by a loaded tandem dump or larger dump truck with certified weight ticket provided by the developer/owner under inspection of the Public Works/Engineering Division. The developer/owner shall notify the Public Works/Engineering Division before the proof roll to set up an appointment with the Inspector. If rain occurs between the proof roll and prior to base placement, another proof roll may be required. It is the responsibility of developer/owner to make corrections to the subgrade when sections of the roadway fail the proof roll test.

<u>Curb & Gutter Placement Inspection</u> - Periodic curb and gutter placement inspections will be conducted by the Inspector to ensure approved materials are being used and the

installation conforms to the standards found in this manual and the NCDOT Standard Specifications. The developer/owner shall notify the Public Works/Engineering Division before curb and gutter placement is scheduled to begin. No concrete will be placed until the forms and subgrade have been approved by the Inspector.

<u>Roadway ABC Stone Base Proof Roll</u> - The ABC stone base will be proof rolled by a loaded tandem or larger truck with certified weight ticket provided by the developer/owner under inspection of the Public Works/Engineering Division. The developer/owner shall notify the Public Works/Engineering Division before the proof roll to set up an appointment with the Inspector. It is the responsibility of developer/owner to make corrections to the ABC stone base and/or subgrade when sections of the roadway fail the proof roll test.

<u>Plant Mix Asphalt Placement and Density Inspections</u> - Periodic asphalt placement inspections will be conducted by the Inspector to insure approved materials are being used and the installation conforms to the standards found in this manual and the NCDOT Standard Specifications. The developer/owner shall notify the Public Works/Engineering Division before asphalt placement is scheduled to begin. The Inspector may require another ABC proof roll if it has been longer than 72-hours since the last proof roll, significant rainfall event, or base has been damaged.

<u>Sidewalk Placement Inspections</u> - Periodic sidewalk placement inspections will be conducted by the Inspector to insure approved materials are being used and the installation conforms to the standards found in this manual and the NCDOT Standard Specifications. The developer/owner shall notify the Public Works/Engineering Division before sidewalk placement is scheduled to begin. No concrete will be placed until the forms and subgrade have been approved by the Inspector. Refer to Appendix 1 & 2 for additional information.

<u>Final Inspection</u> - Prior to roadway maintenance acceptance by the Town of Chapel Hill a final inspection must be conducted. All “As-Built” requirements and punch list items must be completed, and a one (1) year warranty must be provided by the developer/owner for all improvements in the public right-of-way and public easements.

Order of Construction

The Public Works/Engineering Division has the responsibility to determine the acceptability of construction relative to recognized standards and specifications. The developer or their engineer, would be expected to follow the construction sequence should follow Table 10.2:

TABLE 10.2 Construction Sequence for Privately Maintained & Inspected Streets

#	Inspection Activity	Developers Inspector	Inspection Report Filed	P.E. Certification Required***
1	Conduct Preconstruction Conference			
2	Obtain all Permits, Encroachment, Erosion, etc.			
3	Have an approved final set of plans			
4	Stake the clearing limits	X	X	
5	Stake and install all of the erosion control devices possible prior to grubbing	X	X	
6	Clear and grub the site	X	X	
7	Stake and install the remaining erosion control devices	X	X	
8	Slope stake	X	X	
9	Rough grade within R/W and utility easements	X	X	
	Interim Certifications			**X**
10	Temp. seeding and mulching shall be performed as needed to meet the erosion control permit requirements	X	X	
11	Density testing as needed	X	X	
12	Stake and install the storm drainage and sewer mains and services. All services to be outside of the sidewalk limits	X	X	
13	Install erosion control devices around storm drain structures	X	X	
14	Stake and install all water mains and services. All services to be outside of the sidewalk limits	X	X	
15	Stake and install the utility conduits lines	X	X	
16	Density testing as needed on trench lines, specifically within R/W	X	X	
	Interim Certifications			**X**
17	Sub-grade fine grading	X	X	

18	Sub-grade, proof roll and density testing as needed	X	X	
19	First lift of ABC placement	X	X	
20	Staking and placement of C & G	X	X	
21	Backfill of C & G	X	X	
	Interim Certifications			**X**
22	Completion of ABC placement, fine grading and setting up of the ABC	X	X	
23	Proof roll and grade check of ABC, density testing as needed	X	X	
	Interim Certifications			**X**
24	Placement of Intermediate course asphalt	X	X	
25	Shoulder and utility easements to be close to final grade +/- 0.1	X	X	
26	Install utility lines within the utility easements *	X	X	
27	Street light installation	X	X	
28	Grade and place sidewalks	X	X	
29	Finish dressing up shoulders and utility easements	X	X	
30	Placement of surface course asphalt	X	X	
31	Core samples collected on Roadway	X	X	
32	Installation of pavement markings if required	X	X	
	Interim Certifications			**X**
33	Final seeding of R/W and utility easements	X	X	
34	Final Inspection conducted and certifications submitted **	X	X	
	Certification of Completed Project			**X**

* Utility locations and utility installations will be under the inspection of the appropriate utility company. All ditches will be proof rolled prior to base placement.
** Backfill, seeding and mulching, adjustments, cleanup, etc. shall be complete prior to final acceptance.
*** An example certification is in Appendix A.

<u>Purpose</u> - To ensure that new construction inspected by others (consultants, testing laboratories, etc.) meet the Town of Chapel Hill standards before it is accepted as complete.

<u>Requirements</u> - All new construction inspected by others (consultants, testing laboratories, etc.) which is to be accepted as complete must be certified by a registered Professional Engineer.

<u>Expectations</u> - When work which is to be accepted into the town system is following inspections, testing and certifications are expected of the engineer:
<u>Permits</u>

- Verify that all Federal, State and Local permits have been acquired.

- A copy of any Corp of Engineers and Division of Water Quality permits (including any approved modifications) must be submitted with the final certification package.
- A "Verification of Compliance with Environmental Regulations" form must be submitted with the final package (if form hasn't already been submitted during plan approval).

Alignment

- Field verify that vertical and horizontal alignment of all aspects of construction are in reasonable close conformance to the approved plans and to the Town Standards and Specifications.
- Verify that new construction is centered in the platted right of way or utility easement.
- Verify that all materials meet Town Specifications and are installed at the proper elevation.

Grading and Proof Rolling

- Verify subgrade elevation + or - 0.1 foot.
- Verify shoulder width and slope.
- Verify ditch locations and depth.
- Prepare the trench for stone base placement, which should be the approved pavement width + 3 feet.
- Compact the top 8 inches of the subgrade to a density of 100%.
- Perform a proof roll of the full width of the compacted subgrade with a fully loaded dump truck with a total gross weight of at least 40,000 Ibs or equivalent.
- All failures must be repaired and rechecked to complete the proof roll.
- A copy of the proof roll report must be submitted with the final package.
- Aggregate Base Course Placement for Roadways
- Place ABC base material at the required depth with a spreader to avoid segregation and to avoid contaminating the material with earth from the edge of the trench.
- Add water if necessary to achieve the proper moisture content of the material prior to compaction.
- Uniformly compact the material to the required compacted thickness at a density of 100%.
- Verify the top width of the compacted ABC base material to be the approved plan pavement width + 6 inches on each side.
- Verify the approved plan thickness and correct density of the ABC base material prior to placement of any asphalt surface material.

Asphalt Surface Material Placement

- Submit a Job Mix Formula Sheet for all asphalt mixes prior to the anticipated placement of the material.
- All asphalt, used in the work, must come from an NCDOT approved asphalt plant.
- A QMS Certified Plant Technician must be present at the plant during the production of the material.
- A QMS Certified Roadway Technician must be present on site during all placement of hot mix asphalt.
- The approved plan thickness and density for each layer must be verified by an approved testing method performed by the Certified Technician.
- A copy of the Roadway Technician's Report, the completed Job Mix Formula Sheet and the Certification of Pavement Conformance must be submitted with the final package.
- A copy of all thickness and density testing reports must be submitted with the final package.

Roadway Shoulder Construction and Seeding and Mulching

- The shoulders should be constructed in accordance with the approved typical section as soon after the placement of the final surface layer of asphalt as practical using caution not to damage the asphalt.
- Seeding & mulching of shoulders, ditches and back slopes, utility easements and other disturbed areas must be completed within 15 days of completing the construction.
- All required erosion control measures must remain in place until an adequate stand of vegetation is established.

Guardrail Placement

- Guardrail will be placed when warranted and in accordance with the approved plans & NCDOT certified materials.

Sign Placement

- Stop signs at intersections and signing for round-a-bouts will be placed on each road in accordance with the Manual on Uniform Traffic Control Devices and the approved plans.
- A final inspection letter will not be issued until all required signs are properly installed to the appropriate standard.
- All design and construction details not covered above or in the approved plans, should be found in the most current "NCDOT Subdivision Roads - Minimum Construction Standards" or the most current "NCDOT Standard Specifications for Roads and Structures" manuals.

STEP #4: FINAL APPROVAL OF CONSTRUCTION

FINAL APPROVAL OF CONSTRUCTION

- Upon completion of the public infrastructure improvements a Final Inspection will be scheduled with the Engineering Inspector and the Stormwater Engineer.

- Upon satisfactory completion of the Final Inspection punch-list the developer/owner will provide the Town sealed as-built construction plans for the project, a Stormwater Maintenance Bond and Maintenance Manual when required, and a public improvements Warranty Bond in the amount of 25 percent of the original public improvements cost estimate, but not to exceed $50,000.

- If the project is located within Town Limits all public improvements will be accepted for maintenance by letter from the Public Works Department. Projects only within the ETJ will receive a Letter of Completion.

As-Built Drawings

- After the water, sewer, storm drainage and roadway improvements have been constructed, and prior to final acceptance, an "As-Built Drawings" must be submitted.
- A "Record Drawing" shall be marked as such and the Town staff will inspect the job site to verify accuracy of the "As-Built Drawings". If errors are found, the drawing must be corrected and re-submitted.
- Once the Public Works/Engineering Division has verified the "As-Built" to be accurate, the Submitting Engineer must submit the following:
  - One (1) set of signed "As-Built Drawings"
  - Two (2) digital copies of "As-Built" (one DWG format and one PDF format) and two (2) digital copies of the Final Plat (one DWG format and one PDF format).
  - Note: Project must be submitted on one disk or flash drive. Use a DVD or CD as needed.

Public Works/Engineering Division As-Built Submittal Checklist

- The following section provides a list, which should be used by the applicant before any engineering design submittal so that applicants are aware of the minimum requirements in order to receive a complete review.
- The checklists in this section are intended as a guide and may not be inclusive of all the required information.
- The As-Built review checklist is a submittal requirement.

Project Information

Development Name		Phase:
Owner:	Phone:	Email:
Contact Person:	Phone:	Email:

General Requirements

___1. Cover letter

___2. Appropriate checklists completed and attached
___3. All required construction inspection documentation as defined in Chapter 10

Submit all As-Built drawings to Engineering Services & Design, and Planning & Sustainability (if applicable) for Acceptance of Public Improvements. As-Builts should meet ALL items listed for detailed design as well as all utility owner requirements from the appropriate water and sewer service provider listed below:

a. Upon the acceptable completion of all punch list items the Town the Owner/Developer will receive an initial acceptance letter from Engineering.
b. This acceptance begins a warranty for materials and workmanship for not less than one year from the date of acceptance. The warranty period shall continue until all construction activities (i.e., phased project) are completed or no longer impact the area(s) under warranty. The maintenance guarantee will be to the Town from the Owner/Developer.
c. The performance guarantee shall be replaced with a maintenance guarantee in an amount of $50,000 or 25 percent of the cost of the improvements, whichever is less.
d. During the warranty period, the Town assumes ownership of the public facilities and will perform routine maintenance; however, until a letter of final acceptance has been issued, all defects in materials and/or workmanship are the responsibility of the Owner/Developer.
e. No more than 30 days prior to expiration of the warranty period, the Owner/Developer in writing must request a final inspection from the Engineering Division so a letter of final acceptance or a punch list letter can be provided.
f. Upon the acceptable completion of all punch list items, the Owner/Developer will receive a letter of final acceptance from the Engineering Division and the corresponding warranty bond will be released.
g. The Town will begin total maintenance as of the date of the final acceptance letter.

Orange Water and Sewer Authority (OWASA) Standards:
https://www.owasa.org/Data/Sites/1/media/whatWeDo/spec/2015-version-owasa_standards_and_specs.pdf