LAND DEVELOPMENT

STANDARDS MANUAL

Updated July 2025

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Town of Indian Trail Land Development Standards

The Town of Indian Trail's Land Development Standards (ITLDS) is provided as a resource that will assist in ensuring compliance with all Town requirements related to proposed land development activities inside the Town limits and within its Extraterritorial Jurisdiction (ETJ).

The ITLDS is intended as a supplement to the Town's Unified Development Ordinance. The County, State, and Federal agencies may also have additional requirements not provided for or referenced within this manual. This manual does not relieve the design professional of the responsibility to correctly incorporate the provided information. It is the Design Engineer's responsibility to provide technical adequacy of the design using engineering judgment, experience, and sufficient knowledge in providing all related design elements.

The Town of Indian Trail's Director of Engineering shall be responsible for incorporating revisions as deemed appropriate based on a continual review of the ITLDS. The Indian Trail Land Development Manual will be available for online viewing on the Town's website: www.indiantrail.org.

Where discrepancies exist between this manual and any adopted Town Ordinance, the manual shall govern. The latest revision of the "NCDOT Standard Specifications for Roads and Structures" and the "NCDOT Design Manual" shall apply to all roadway and storm drainage construction unless otherwise specified herein this manual.

This manual was created to capture most, but not all, scenarios related to development within the Town of Indian Trail. The Town reserves the right to enforce standards not included within this manual, which uphold the Town's initiative to maintain a safe and prosperous environment for its citizens.

Any variations from the standard details shown herein shall be by special details shown on the project drawings and are subject to approval by the Town of Indian Trail.

I. GENERAL PROCEDURES

A. General Plan Procedures

1. Introduction

The Town has processes and procedures for development and redevelopment that an individual needs to abide by. This manual will discuss these processes and procedures in detail. The manual will also provide information on plan review and development standards in regard to development and redevelopment.

2. Electronic Plan Review Process

The Town utilizes an electronic plan review management software for its plan review and permitting process. This web-based workflow tool allows developers, designers, and engineers the ability to monitor the progress. This plan review process is required for all new and proposed development/redevelopment. Additional plan submittal and checklist requirements can be found in the Town's Unified Development Ordinance.

3. Fee Schedule

Fees are set and collected by the Town of Indian Trail. The Planning Department collects all plan review, permit, and technical fees. The Engineering Department collects payment for all bond processes and SCM inspection fees. Fees vary by type and size of development and bond request. The fee schedule can be found in the Town's annual budget report, and online at www.indiantrail.org.

4. Bond Program

The Town offers a bond program as a premium administration service to the development community and is designed to ensure the completion of required public improvements. All requirements for this program are described in more detail in the Unified Development Ordinance. Below are the different types of bonds the Town will accept as a resource to contribute to the completion of the project. However, the surety types differ in their purpose and application.

Cash Sureties: A certified check or money order made payable to and deposited in the Town of Indian Trail's escrow account. A cash surety serves as a financial resource for the completion of improvements by the Town of Indian Trail in the event of Developer/Builder default. A Cash Deposit provides protection until the Town of Indian Trail returns the funds to the developer/builder. No renewal or policy terms are required.

Letter of Credit: Developers/Builders obtain Letters of Credit from banks where they have established lines of credit/open loans. A letter of credit serves as a financial resource for the completion of improvements by the Town of the Indian Trail in the event of Developer/Builder default. Letters of Credit are generally effective for a minimum term of two years, with the expiry date clearly indicated on the document. The Town of Indian Trail requires all new and renewal letter(s) of credit for developer streets, sidewalk, right-of-way, and SCM bonds to contain the "Evergreen Clause". The "Evergreen Clause" specifically states the expiration of a letter of credit will not take place without a sixty-day (60) notice by the issuer (the bank) to the Town of Indian

Trail. If prior notice of expiration is not given by the issuer (the bank), the letter of credit is automatically extended for one year.

Surety Bond: A Surety Bond is an agreement under which one party, the Surety (the surety company), guarantees to another party, the Owner or Obligee (the Town of Indian Trail), that a third party, the Principal (the developer or builder), will perform a contract (i.e., the subdivision plat or development) in accordance with the terms and conditions of the contract agreement. There are several types of Surety Bonds. Performance Bond is required by the Engineering Department to protect the Town of Indian Trail from financial loss should the Principal fail to perform the contract and is unable to complete the required public improvements or development. The Surety investigates the financial history and past performance of the Principal before underwriting a surety bond. The Surety evaluates the Principal's "Four C's", Character, Continuity, Capital and Capacity. This is accomplished with a thorough review of references, experience, ability, financial strength, credit history, established relationships and lines of credit. Establishing an initial relationship with a Surety requires an investment of time and effort on the part of the Principal. The Surety must be satisfied that the developer is a well-managed, profitable enterprise that keeps promises, deals fairly and performs obligations in a timely manner. Surety Bonds are distinctly different from insurance products. Since surety bonds guarantee a Principal's performance, the Surety fully expects that the Principal will honor their obligations. A surety bond may provide financial and/or project management resources for the Town of Indian Trail. In the event of Principal default, the Surety may finance completion by the existing developer, assume responsibility and complete the project using developers of its choosing, or pay the Obligee (the Town of Indian Trail) the amount required to complete the project. Payment to the Obligee will never exceed the "penal sum" (face amount) of the bond; therefore, an accurate bond estimate is critical to ensure project completion in the event of Principal default. A surety bond serves as a financial resource for the completion of improvements by the Town of Indian Trail in the event of Developer/Builder default. Surety Bonds generally specify a term of one to two years within which the required improvements will be completed. The Town of Indian Trail requires a "continuation" or "verification" certificate to be provided by the Surety sixty (60) days prior to the end of the last verified term of the bond. The continuation certificate amends the original document to reflect the extension of the effective date of coverage shown on the original bond for a period of no less than one full year.

The Town will allow a one-time reduction on any new or existing bonds as long as the applicant can provide evidence that over 75% of the improvement listed on the bond has been completed to the satisfaction of the Town's requirements.

The release process can begin once the applicant requests an inspection by Town staff on the improvements listed on the bond. Once the inspection is completed and a report is issued, the applicant will receive a list of repairs that need to be corrected. After repairs are completed to the Town's satisfaction, then a release of the bond will be granted. As stated previously, language on these processes is stated in greater detail in the Unified Development Ordinance.

5. Development/Redevelopment Close-Out Procedures

No certificate of occupancy or release of sureties will be issued for any development until:

- As-built drawings of all storm drainage, detention, and water quality features have been submitted by a professional land surveyor. The final approved drawings shall be submitted electronically in an AutoCAD version with geospatial referencing.

- Any required revised calculations have been submitted and approved by the Town. Said revised calculations must be sealed by a North Carolina Registered Professional Engineer.

- The facility has been stabilized consistent with the North Carolina Department of Environment and Natural Resources standards and specifications.

- The as-built survey, final calculations, and facility have been inspected and approved by the Town.

II. STREETS

A. General

The latest revision of NCDOT "Standard Specifications for Roads and Structures" shall apply unless otherwise specified herein. The following substitutions shall be read into the aforementioned specifications:

"State" or "Commission" shall be replaced by "Town of Indian Trail".

"Resident Engineer" shall be replaced by "Director of Engineering or their authorized representative".

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

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

Public streets shall be designed and constructed to Town Standards unless NCDOT Standards are applicable. NCDOT Standards shall be applicable on all existing state roads, extensions of state roads, or roads expected to be maintained by the state.

The development's design shall be within the specified tolerances of the lines, grades, grading sections, cross sections, dimensions, material requirements, and testing requirements that are specified in approved plans and specifications of the design.

For the purpose of this subsection, the term "reasonably close conformity" shall not be construed as waiving the developer's responsibility to complete the work in accordance with the approved plans. The term shall not be construed as waiving the Town's rights to insist on strict compliance with the requirements of his manual.

B. Design and Criteria

1. Street Classifications

Streets are classified according to the nature of the land uses they serve and the mode of travel (non-motorized and motorized) they accommodate. Streets are networked to provide a balance between access and mobility.

All streets shall conform to the Town of Indian Trail Comprehensive Transportation Plan when applicable or shall be designed and located in proper relation to existing streets and the surrounding environment. Street design should be consistent with topography and preserve developed properties and community values.

All streets shall be networked to provide safe and efficient access to all properties. No properties shall be landlocked or excessively removed from the street facilities.

i. Minor Local Streets

Cul-de-sacs serve either abutting residential or non-residential land uses and terminate in a turnaround. The standard maximum length for a cul-de-sac shall be 900 feet. The length may be varied by the Town Council depending upon the density within the subdivision. The recommendation for a variance shall consider the development density, land configuration, as well as all safety concerns. The length of a cul-de-sac shall be measured from the last point of alternate access.

No median shall be allowed in a 45 foot radius cul-de-sac. A median may be permitted where the cul-de-sac radius is increased and it can be demonstrated that all emergency vehicles can be readily accommodated.

Loop streets serve abutting residential land uses, terminate on the same street from which they originate, and shall not exceed 1500 feet in length. Short residential cul-de-sac streets may intersect onto this street.

ii. Major Local Streets

Residential Local Street's primary function is to serve an abutting residential land use. Motorists using such streets generally include only residents and their visitors. Use of such streets by large trucks and heavy vehicles is rare, except for occasional use by maintenance and delivery vehicles. Primary design concerns focus on fostering a safe and pleasant environment for the residential community, with convenience to the motorist secondary.

Residential streets in new developments may incorporate traffic calming into the initial design. Traffic calming may include curvilinear streets and/or devices such as median islands, chokers, chicanes, roundabouts, etc.

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

iii. Collector Streets

Collector streets provide a balance between land access and mobility within residential, office neighborhoods and commercial areas. These are streets which penetrate various land use classifications. They typically serve as a link between local streets and thoroughfares. The typical section generally consists of two travel lanes, striped bike lanes, and sidewalks on both sides.

The design requirements for Collector streets are as follows:

- Minimized driveway cuts along Avenues. A minimum distance of 160 ft.

between driveway cuts will be required. Exceptions to this requirement must be approved by the Director of Engineering.

- Installation of bicycle facilities in the form of striped bicycle lanes may be required. (Note: Thermoplastic pavement markings will be required for lane and bike lane accommodations).

- On-street parking will not be permitted unless its offset by marked spaces and bulb-outs are provided for pedestrian safety.

- Materials selection and layout for permanent turf, plantings, and plant beds will be illustrated on the submitted plan for review. Medians and traffic island landscape maintenance will be the responsibility of the Homeowner's Association. All ornamental plantings shown on the plan will be maintained by the Homeowner's Association. A maintenance agreement will be required as part of site plan submittal. Planting design shall be submitted and approved with site plan.

iv. Minor Thoroughfares

Minor thoroughfares are designed for posted speeds of 35 to 45 miles per hour. They provide two travel lanes and wide outside lanes or striped bike lanes. On-street parking will not be permitted unless marked spaces are provided that do not block through lane or bike lane.

v. Major Thoroughfares

Major thoroughfares are designed for posted speeds of 45 to 55 miles per hour. They provide four travel lanes including wide outside lanes to accommodate experience cyclists. No on-street parking allowed.

vi. Private Streets

Private streets can be permitted for commercial, multi-family, and gated residential subdivisions. A request to have private streets for a particular development shall be requested early in the zoning process and be approved by the Director of Engineering.

Private streets must provide 11' minimum lane widths, 0.02 cross slopes, 90' minimum horizontal curve length, and 75' minimum vertical curve length as defined by the Town Standards. Deviations from the minimum standard requirements will require approval by the Director of Engineering.

Where private streets are proposed within site/subdivision plans, the marketing materials and property deed information should clearly state that the streets within the development are private streets; are not and will not be maintained by the Town of Indian Trail; and do not meet current Town of Indian Trail Standards. The marketing materials and property deed information must be submitted with the site plan submittal and reviewed by Staff prior to final site plan approval.

If on-street parking is provided, the parking area shall in no way block or obstruct two-way travel lanes or bike lanes.

2. Design Speed

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

Once selected, all pertinent features of a street, such as width, curvature, sight distance, access points and parking should be related to the design speed. All town roads shall be 25 mph.

3. Traffic Congestion

i. General

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

ii. Vehicles

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

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

Collector streets are to be designed to accommodate single-unit trucks, or in the case of a non-residential setting, the streets shall accommodate the type of vehicle prevalent to their access purpose.

Thoroughfares shall meet the design needs of vehicles specified by NCDOT.

iii. Pedestrians

The trip purpose and ability of a pedestrian are important factors affecting the design of streets and pedestrian facilities. The purpose and frequency of pedestrian trips, as well as the variability in the abilities of the pedestrians themselves, are heavily dependent upon the adjacent land uses. Measures should be employed to facilitate the pedestrians' use of a roadway and help to reduce pedestrian-vehicular conflicts. More information on pedestrian characteristics and facilities can be found in FHWA's "Pedestrian Facilities Users Guide".

iv. Bicycles

The physical dimensions and abilities of a bicyclist are important factors affecting the design of streets and bicycle facilities. While the physical dimensions are relatively consistent, the skills, confidence, and preference of bicyclists vary dramatically. The design of bicycle facilities will vary with user type, roadway characteristics/conditions. Measures should be employed to facilitate the bicyclist's use of a roadway, help to promote bicyclist use of a roadway and help promote bicyclist/motor vehicle safety and operation. More information on bicyclist characteristics and bike facilities can be found in AASHTO's "Guide for Development of Bicycle Facilities".

4. Access Management

i. Driveways

Any person desiring to construct a driveway or other connection within the right-of-way of a public street must secure a permit prior to construction. Connections from single family and duplex dwellings are excluded unless access is requested to a thoroughfare. Failure to secure a permit prior to construction may result in the removal of the driveway(s) at the expense of the property owner and/or denial of access at that location. All driveways must conform to the design and construction standards established by the Town of Indian Trail Land Development Standards.

Subdivisions with less than 75 lots shall provide a minimum one means of ingress/egress designed as a three-lane entrance consisting of an entrance lane, left turn out, and right turn out. Main entrance stem length shall be a sufficient length for design or be approved by the Director of Engineering.

Every major subdivision with more than 100 lots and/or building units must have at least two means of ingress/egress, and major subdivisions with 200 lots or more shall have at least three means of ingress/egress to the subdivision that afford reasonable access for emergency vehicles as well as for all residents/visitors who need or desire access to the subdivision. These means of ingress/egress shall be on different roads wherever feasible. Regardless of the number of lots, entrances shall not be gated or otherwise restricted to public access; unless otherwise granted approval through the rezoning process.

Any multi-family/apartment project with more than 200 units shall provide at least two means of ingress/egress that afford reasonable access to emergency vehicles, as well as residents and visitors to the community.

The Director of Engineering and/or Town Council can approve an increase in the number of dwellings with one entrance per the recommendations of the TRC and the Fire Marshal based on conditions listed in the Unified Development Ordinance.

The arrangement of driveways should be related to adjacent driveways and nearby street intersections. Non-residential driveways accessing local or collector type streets shall be at least 100 feet from the point of tangency of the radius curvature of the next intersecting street. Non-residential driveways serving traffic volumes in excess of 300 ADT or accessing thoroughfares shall be located a minimum of 250 feet from the point of tangency of the radius of curvature of the intersecting street.

Where two non-residential driveways are proposed along a single property frontage

to facilitate operations, the minimum distance between the centerlines of the drives shall be 250 feet. The minimum distance between the centerlines of driveways into shopping centers or facilities generating in excess of 300 ADT shall be a minimum of 600 feet. Full access driveways open to signalization should be 1,200' apart.

Non-residential driveways which access thoroughfares and serve more than 1500 ADT shall provide deceleration lanes in approach to the driveway. Residential drives shall be located a minimum of 10 feet from the point of tangency of curb radii of street intersections.

ii. Streets

There shall be a minimum of 250 feet between centerlines of street jogs on collectors and thoroughfares. Local streets shall not be offset less than 125 feet from their centerline.

Median crossovers and/or signalized intersections shall be evaluated from an operational and safety perspective and provided to allow safe and efficient movement of traffic. The availability of adequate spacing, existing crossovers, alternative routes, and access points shall be considered in all proposed crossover locations.

Median crossovers and/or signalized intersections should be spaced along roadways at the following intervals:

Thoroughfares	2,000' (posted speeds > 45 mph)
Thoroughfares	1,200' (posted speeds 45 mph and less)
Collector Streets	1,200'
Local Streets	1,000'

Table 2.1 - STREET DESIGN MATRIX

	DIMENSIONAL ELEMENTS																
Street Classifications	**Vehicle Volume (vpd)**	**Design Speed (mph)**	**Posted Speed (mph)**	**Pavement Width (B-B FT) (min)**	**Min. ROW Width (FT)**	**Length (LF) (max)**	**Horizontal Centerline Radius (min)**	**Vertical Curve "K" Value (min)**	**Max Grade (%) (max)**	**Tangent Length (FT)**	**Min. Utility Esmt. (FT)**	**Cul-de-Sac Radius (FT)**	**Corner Radius (FT)**	**Crown Section**	**Standard Typical Section (min)**	**Curb & Gutter**	**Sidewalks (6 FT min)**
Private Streets	400 (max)	20 mph	20 mph	11 FT min Lane Width	50 FT	900 LF (max)	125 FT	15 Crest & Sag 10 Stop	10%	N/A	N/A	45 FT (min)	20 FT (min)	Normal: 1/4" / FT	3" Asphalt 8" ABC	N/A	N/A
Minor Local Streets: *Residential Cul-de-sacs & Minor Loop Streets*	400 (max)	25 mph	25 mph	28 FT	50 FT	900 LF (cds max) 1,500 LF (Loop Max)	150 FT	20 Crest 30 Sag 15 Stop	10%	N/A	5' Each Side	45 FT (min)	25 FT (min)	Normal: 1/4" / FT	3" Asphalt 8" ABC	24" Std or 24" Valley	Both Sides[1]
Major Local Streets: *Residential Local and Access Streets*	1,000 (max)	30 mph	25 mph	28 FT	50 FT	1,500 LF (max)	225 FT	25 Crest 40 Sag 20 Stop	9%	500 FT (max)	5' Each Side	45 FT (min)	25 FT (min)	Normal: 1/4" / FT	3" Asphalt 10" ABC	24" Std or 24" Valley	Both Sides
Collector Streets	1,000-3,000 (max)	35 mph	35 mph	28 FT (min)[2]	50 FT (min)[3]	N/A	370 FT	30 Crest 50 Sag 25 Stop	9%	N/A	5' Each Side	N/A	30 FT (min)	Normal: 1/4" / FT	4.5" Asphalt 10" ABC (min)	30" Std	Both Sides
Minor Thoroughfares	3,000 - 8,000 (max)	45 mph	35-45 mph	**NCDOT STANDARDS**												30" Std	Both Sides
Major Thoroughfares	>8,000 (max)	60 mph	45-55 mph	**NCDOT STANDARDS**												30" Std	Both Sides
Commercial	< 3,000 (max)	35 mph	35 mph	36 FT	60 FT	600 LF	225 FT	30 Crest 50 Sag 25 Stop	10%	N/A	5' Each Side	50 FT (min)	40 FT (min)	Normal: 1/4" / FT	5" Asphalt 12" ABC (min)	30" Std	Both Sides
Industrial	< 3,000 (max)	35 mph	35 mph	36 FT	60 FT	600 LF	225 FT	30 Crest 50 Sag 25 Stop	8%	N/A	5' Each Side	50 FT (min)	40 FT (min)	Normal: 1/4" / FT	Pvmt Design Req.	30" Std	Both Sides

[1] Sidewalk: If cul-de-sac is less than 450 LF, sidewalk on one side is permissible.

[2] Pvmt. Width: Collector streets may require wider sections due to turn lanes, bike lanes, etc.

[3] ROW Width: Collector streets may require wider ROW due to turn lanes, bike lanes, etc.

C. Typical Cross Section Elements

The elements which compose the cross section of a street should take into account the classification, design speed, traffic volume, traffic composition, and terrain of that street. The elements of the cross section include the roadway (curbs, shoulders, traveled way, bike lanes and parking lane), roadside (utility strips, sidewalks, and multi-use paths) and median area. All of these elements lend themselves together into determining the required right-of-way width.

1. Roadway

Any development located adjacent to public or private streets must provide curb, gutter, sidewalks, and access management, along its street frontage in accordance with the Town of Indian Trail Comprehensive Plan and Unified Development Ordinance.

i. Driveways

A pavement design detail will be required for all collector avenues, major collector streets, industrial park, and thoroughfares. A pavement design detail shall also be required for all streets located within areas with Triassic soils. The pavement design shall be in accordance with these specifications.

- The pavement design and traffic analysis shall be signed and sealed by a North Carolina Professional Engineer, and shall be submitted for approval prior to placement of curb and gutter or pavement material. All streets maintained by the NCDOT must receive approval of the pavement design from the NCDOT prior to the placement of curb and gutter or pavement material.

- Approved pavement design methods include those most current as proposed by NCDOT, AASHTO and the Asphalt Institute MS 1 document. Other design methods will not be accepted.

  - ❖ The AASHTO method will require use of a terminal serviceability index of 2.0 for collectors and 2.5 for thoroughfares, $S_o = 0.49$ for flexible pavement or $S_o = 0.39$ for rigid pavements, and a reliability of 98 percent for thoroughfares and 95 percent for collectors.

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

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

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

- Soil samples used for these CBR tests shall be obtained at intervals not greater than 500 feet. Typically, a subdivision will require 2 to 3 soil samples as a part of the pavement design. Larger subdivisions, greater than 100 lots, may require additional soil samples at the discretion of the Director of Engineering.

- Boring logs and scaled drawings designating boring locations with CBR tests and other pertinent data shall accompany the pavement design.

ii. Utility Strips

Utility strips shall be sufficient to permit the adequate installation and maintenance of sidewalks and utilities, as well as provide sufficient clear distance as defined by NCDOT.

Shoulder sections without sidewalk shall be 10 feet wide on all streets that have a cross section of 35 feet or greater.

iii. Drainage Channels and Side Slopes

Streets designed without curb and gutter, due to existing environment impacts, must meet all of the following requirements and be approved by the Director of Engineering.

- Minimum 50 feet of right of way
- 5% maximum and 0.5% minimum vertical grade;
- Swales shall carry the 10 year storm in a non-erosive manner;
- Driveway pipes shall pass the 10 year storm
- Driveway pipes shall have flared end sections or headwalls on both ends.

iv. Curb and Gutter

- Curb and gutter shall be required on all streets unless approved by the Director of Engineering due to environmental considerations
- Curb and gutter shall comply with the Standard Details.
- A minimum 5 foot section of curb and gutter shall remain when removing curb for the installation of a driveway, street turnout or repair of curb and gutter. When less than 5 feet of the curb remains, the curb shall be removed to the next joint.

v. Sidewalk

Sidewalks shall be constructed within the street right of way or within a dedicated sidewalk easement in accordance with Town Standards and Town policy. Sidewalks shall be installed at the time of roadway construction or widening unless it's part of a planned subdivision, or otherwise approved by the Director of Engineering.

Sidewalk requirements are as follows:

- Thoroughfares, all collector streets, and non-residential cul-de-sacs shall have sidewalk on both sides.

- Major and minor local streets shall have sidewalk on both sides.

- Loop and residential Cul-de-sac streets: Loop road systems will be handled on a case-by-case basis. Cul-de-sacs will require sidewalks on both sides unless otherwise stated in standard details.

- The minimum thickness of a sidewalk shall be 4 inches. A 6 inch depth is required at locations where a driveway crosses a sidewalk, at street intersections (along the length of radius curb returns), and in the handicap ramps.

- Sidewalks shall have a uniform slope toward the roadway of 0.02' per foot. The utility strip between the sidewalk and the back of curb shall slope at ¼" to ½" towards the roadway.

- Sidewalks shall be a minimum distance of six (6) feet off of the back of curb. All sidewalks placed along public or private right-of-way shall be a minimum of six (6) feet in width.

- Sidewalks that are placed along the back of the curb shall be a minimum width of six (6) feet. (This type of placement will be on a case-by-case basis and shall have prior approval from the Director of Engineering).

- Where sidewalks and/or greenways intersect any section of curb and gutter, a curb ramp shall be installed.

- During construction activities and incomplete projects, temporary measures may be required to provide accessibility.

2. Median Sections

Raised median sections shall be a minimum of 16 feet wide measured from the back of curb to the back of curb to provide 11 feet for left-turning vehicles and 4 feet for the placement of signs and separation of traffic at median openings. It is desirable to have continuous median sections on thoroughfare roadways. In no case shall plantings within a median obstruct required sight distance.

Medians shall have sufficient crown (0.5" per foot) to promote drainage off the median, but shall never be to a cross slope in which sight distance is obstructed.

3. Directional Cross-Over (Leftover)

The directional crossover or left-over design eliminates full-movement median openings. Traffic on the major street (thru, left, right) are still permitted. Traffic on the secondary street must turn right onto the major street. This type of crossover design will be used in various situations.

4. Roundabouts

Roundabouts are circular intersections with specific design and traffic control features. These features include yield control of all entering traffic, channelized approaches, and appropriate geometric curvature.

Roundabouts require a minimum 135' outside diameter (67.5' radius), edge-of-pavement to edge-of-pavement, to accommodate emergency and fire apparatus vehicles unless approved by the Director of Engineering

Mini-roundabouts will be approved on a case-by-case basis.

D. General Design Elements

1. Horizontal Alignment Controls

i. Superelevation

Superelevation shall be designed when dealing with thoroughfare only. See Table 2.1 Street Design Matrix on page 10.

ii. Tangent Lengths

- Collector Streets

  Tangent sections shall be of sufficient length to accommodate minimum super elevation runoff lengths as noted in the latest edition of AASHTO's, "A Policy on Geometric Design of Highways and Streets". The minimum tangent length on the stop approach to an intersection of a higher classification shall be 100 feet.

- Local Streets

  Tangent sections shall not exceed 300 feet for minor local streets and 500 feet for major local streets. The minimum tangent length approaching an intersection is 30 feet.

iii. Curves

Curves are to be designed to establish the proper relation between design speed and superelevation. The minimum radius of curvature is limited by a given design speed and superelevation rate. The maximum and minimum radii of curves for each roadway class is specified in Table 2.1.

Horizontal and vertical curves should be designed concurrently so as to encourage uniform speed, and accent or preserve the significant natural features of the land.

Whereas, the maximum radius of curvature is limited by the posted speed (85th percentile) and the associated expectations of pedestrians and motorists for the adjacent land use.

2. Vertical Alignment Controls

i. Grades

Street grades shall be established such that drivers can negotiate in adverse weather.

The minimum grade allowed on any street shall be one percent (1%), and the maximum grade shall be ten percent (10%).

The maximum grade allowed when approaching an intersection is five percent (5%) for the last 100 feet of pavement before the intersection. The maximum grades allowed per street type classification are listed in Table 2.1.

ii. Curves

Vertical curves affect the gradual change between grades of a vertical alignment. The curves should produce a design which provides adequate sight distance, proper drainage, and rider comfort. To meet these criteria, the vertical curves are designed to curve at rates specified in Table 2.1. The product of the curvature rates and the algebraic difference in adjoining grades is the basis for the minimum length of curves, but should never be less than the minimum lengths provided in Table 2.1.

- Crest Vertical Curves

  The design of crest vertical curves should focus on providing sufficient sight distance. Crest vertical curves which are too abrupt in their curvature can impede the line of sight to drivers and thereby limit sight distance.

- Sag Vertical Curves

  The design of sag vertical curves should focus on rider comfort and drainage. Sag vertical curves which are too abrupt in their curvature can magnify the effects of the gravitational and vertical centrifugal forces acting on a rider. Sag curves which are too gradual can create substandard drainage conditions within the curve. The rate of vertical curvature is to ensure that a minimum grade of 0.003 ft./ft. is obtained within a 50' distance from the level point. In addition, sag vertical curves in cut situations should be avoided to prevent potential problems associated with the ponding of water.

  The Director of Engineering may approve street lighting which exceeds the standard Town requirements for residential streets so as to reduce the length of sag vertical curves, provided the street lights are operational prior to the issuance of any Certificate of Occupancy on such street. The minimum allowable length of sag vertical curves, where a street light is in the sag, shall be approved on a case-by-case basis with supporting calculations.

3. Traffic Control

i. Traffic Signs, Pavement Markings, and Street Name Signs

All streets require traffic signs. All collectors and thoroughfares require traffic signs and pavement markings. Traffic signs and pavement markings shall be marked in accordance with the latest revision of the MUTCD unless otherwise approved by the Director of Engineering.

All stop signs in town limits shall be a minimum of 30"x30". All speed limit signs shall be a minimum of 24"x30".

Where two public streets cross or where a private street meets a public roadway and signalization is not warranted, a stop bar and stop sign shall be used on the minor street approaches. Stop bars must be located 4 feet behind a crosswalk, if present. Stop bars shall be striped at all stop sign locations.

A pavement marking and signing plan showing description and placement of traffic signs, pavement markings, and specialty signs shall be submitted with all roadway and subdivision plans as a requirement of the Developer, and shall be in place prior to issuance of a Certificate of Occupancy for the development or final acceptance of the roadway by the Town.

All new signs must use prismatic sheeting and meet the minimum retro-reflectivity levels shown in the latest edition of the MUTCD. Signs provided for pedestrian and school crossings and zones shall use the strong yellow-green coloring rather than the traditional yellow of warning signs. The pavement markings for all streets, both public and private, shall be thermoplastic in accordance with NCDOT standards. Exception of the use of thermoplastic is granted in the case of private parking stalls.

Traffic Control and Street Name Signs within subdivisions which will be maintained by the Town shall be consistent with the MUTCD. Requests for specialty signs (traffic control, street name signs and post, etc.) shall be submitted to and approved by the Director of Engineering.

At signalized intersections, street name signs should be mounted overhead. The designer should determine the best attachment type. Oversized signs will be used at major intersections.

ii. Traffic Signals

The design, installation and construction of traffic signals shall meet the specifications put forth by NCDOT's Traffic Engineering Branch in the latest version of the "Traffic Management and Signal Systems Unit Design Manual".

iii. Traffic Calming

All traffic calming devices must be shown and approved as a part of a site plan prior to installation and must be in conformance with the Specifications. The traffic control devices and all related signs and pavement markings shall be maintained by the Owner. Traffic control devices may include rumble strips, raised pavement markers or pavement undulations (speed humps) or other devices, listed in the

Town's Neighborhood Traffic Calming Policy or approved by the Director of Engineering.

- Rumble Strip

  An irregular surface established to draw the attention of motorists and alert them of potential hazards or conflicts. The material used as a part of a rumble strip may be cobblestone, stamped concrete, brick or rough surface asphalt. A rumble strip may not vary more than one (1) inch in height from the pavement elevation. All rumble strips must be located outside any public right of way.

- Raised Pavement Markers

  Raised pavement markers may be used to create an irregular surface to draw the attention of motorists and to alert them of potential hazards or conflicts. The markers must be made of a flexible and durable solid material designed to support vehicular traffic. The placement of markers may be staggered in a manner as approved by the Director of Engineering. All raised pavement markers shall have a maximum height of 1 inch above the pavement surface. The minimum size of the marker shall be 4 inches by 4 inches. The markers must be located outside any public right of way. All raised pavement markers shall have cube- corner microprism reflectors visible from either direction of travel.

- Pavement Undulation (Speed Hump)

  A pavement undulation is a gradual raised pavement surface which transverses the travel way, commonly known as a speed hump. The surface material for a pavement undulation shall be the same as the adjacent travelway, typically asphalt.

  Speed humps installed on public or private roadways shall be flat- top and conform to the standard dimensions found in Detail No. T_20.01. When speed humps or bumps are desired in paved areas other than streets, such as parking lots, they should be parabolic and a design submitted to the Director of Engineering for approval.

  All speed humps shall be clearly marked with pavement markings and warning signs for each direction of travel (Detail No. T_20.01). Pavement undulations must be located a minimum distance of 500 feet from a signalized intersection. The Town and/or NCDOT may require the removal of any speed undulation which causes traffic to back up onto a public street.

- School Speed Zone Flashers

  According to North Carolina General Statute 20-141.1, the speed limit in all school zones will be reduced by 10 mph. For all schools in the Town of Indian Trail, this school speed zone will be designated using a school speed zone flasher assembly. All schools will be responsible for coordinating with the Town of Indian Trail and/or NCDOT on the location and design of

school speed zone and the flasher units.

iv. Lane Configuration

Tapers shall be used as necessary in street design. Approach tapers are used to shift lanes laterally. The following equations shall be used as applicable:

$L = WS$ for posted speeds of 45 mph and greater;

$L = WS^2/60$ for posted speeds of 40 mph or less;

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

4. Pedestrian and Bicycle Facilities

The implementation and location of pedestrian crosswalks shall adhere to NCDOT Standards for Roadway Design.

i. Pedestrian Crosswalks – General

All locations which are designated for pedestrian traffic crossings shall be designated as a crosswalk with pavement markings and signage during the submittal process. The type and placement of signage and markings shall be consistent with MUTCD.

Marked crosswalks should be provided at all stop-controlled approaches and signalized intersections where sidewalks, greenway trails, or multi-use paths exist or will be provided. For standard pedestrian crosswalk pavement markings, use two parallel line markings to denote the crosswalk area. For greenway trail and multi-use paths crossings on all roadways, use high visibility crosswalk markings.

For pedestrian crosswalks on stop-controlled approaches, no signing is required to denote the presence of the facility.

ii. Pedestrian Crosswalk – Mid Block Crossings

Marked pedestrian crossings at non-stop controlled locations (mid-block) shall be avoided for public roadways with the following characteristics:

- Where the street is a multi-lane (4 or more lane) street *without* raised medians and the Average Daily Traffic (ADT) volumes exceed 9,000 OR the posted speed limit is 30 MPH or greater.

- Where the street is a multi-lane (4 or more lane) street *with* raised medians and the ADT volumes exceed 12,000 and the posted speed limit is 40 MPH or greater.

- Where the street provides three travel lanes AND the ADT volumes exceed 9,000 OR the posted speed limit is 40 MPH or greater.

- Where the street is residential in nature, providing two travel lanes and the

ADT volumes are less than 400 OR greater than 12,000.

- Raised medians must be 4 feet or greater in width and 6 feet or greater in length to provide an adequate pedestrian refuge.

- If a mid-block crossing is approved, the crossing shall utilize high-visibility markings and W11-2 signs with W16-7P placards. Signs shall be provided for both directions of travel and will located in the direct vicinity of the crossing.

- It may be acceptable to use raised pedestrian crosswalks with stamped concrete in place of the high-visibility pavement markings on private streets. If this option is used, the W11-2 and W16-7P signs must be used.

- Appropriate sight distance shall be provided for mid-block pedestrian crossings. Refer to the latest version of AASHTO's Policy on Geometric Design of Highways and Streets to calculate the appropriate stopping sight distance.

iii. Bicycle Facilities

Bicycle lanes shall be separated from the vehicular traffic with a 4" white edge line. The lane will be designated as a bicycle lane with standard pavement markings as shown in the MUTCD. This should include a bicycle symbol followed by a through arrow. Signs should be placed at the beginning and end of the bicycle lane as well as along the corridor. Appropriate signage should be considered after major intersections or after cross-section changes. All signage shall be approved by the Director of Engineering.

5. Street Lighting

The owner or developer of a site plan or subdivision shall be required to install street lighting via underground contribution, unless specifically approved otherwise by the Director of Engineering, along all proposed streets and along all existing streets, which adjoin the property.

E. Specific Design Elements

1. Intersections

i. Alignment

Streets shall intersect each other at right angles whenever possible. The minimum desirable intersection angle is 80 degrees. At no time shall a street intersect any other street at less than 75 degrees.

ii. Layout Configuration

Curb radii shall be designed to satisfy the turning radius of the predominant design vehicle using the roadway. Minimum radii are listed in Table 2.1.

Turn bay tapers shall be straight line at a ratio of 15:1 for posted speeds of 45 miles per hour and more. The minimum turn bay taper allowed is 8:1 for posted speeds below 40 miles per hour. Symmetrical reverse curve tapers are recommended for non-thoroughfare streets.

Storage lengths for the turn bays shall be calculated using an acceptable method.

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

iii. Intersection Corners

A minimum 35' x 35' sight triangle shall be provided at each intersection corner. This is the triangular area formed by a diagonal line connecting two points located on intersecting right-of-way lines, or a right-of-way line and the curb or edge of pavement or a private street or driveway, each point being 35 feet from the intersection, and the two intersecting right-of-way lines (or right-of-way line and curb cut).

An additional 10'x70' sight triangle shall be provided at intersections connecting to NCDOT maintained roadways.

Additional sight distance requirements may be required by the NCDOT or the Director of Engineering.

Any variance to this requirement may be approved by the Director of Engineering on a case-by-case basis depending on the speed limit.

iv. Intersection Sight Distance

- Sight Distances

  All street intersections on state or publicly maintained roadways, and all driveways with egress onto a state or public maintained roadway must comply with the requirements of this section.

  All intersections and driveways must adhere to the requirements set forth in the most current edition of NCDOT Policy on Street and Driveway Access to NC Highways. In instances where the sight distance requirements are unable to be met, the Director of Engineering can:

  - ❖ Deny the application for a driveway permit
  - ❖ Request the driveway or intersection location be modified to achieve a more favorable site distance. Request will be followed with a sealed letter and drawing from a Professional Engineer
  - ❖ Request driveway to modified to a right-in right-out only
  - ❖ Request a deceleration lane and a right turn acceleration lane, designed in accordance with AASTHTO standards

- Sight Distance Obstructions

  Some objects located within sight distance areas may not significantly obstruct the required visibility of the driver. The driver may be able to see over, under or around some objects within sight distance areas.

  Objects that may be required within sight distance areas include fire hydrants, utility poles and traffic control devices which are located to minimize visual obstruction. Other objects 12 inches in diameter and smaller, such as tree trunks and sign posts, may be allowed within the sight distance areas if located so as to not substantially restrict the driver's view. The Director of Engineering shall determine what objects, if any, may be located within sight distance areas. Trees located in the right of way shall be evaluated in accordance with other applicable Town policies and requirements considering health, safety and welfare.

  Some conditions may exist that prevent the attainment of desirable sight distance. In such cases, the maximum practical sight distance shall be obtained. In addition, where desirable sight distance is not attained, additional measures such as warning signs, reduced speed zones and other traffic controls may be imposed. In all cases, unless otherwise provided by Professional Engineer or granted an exemption from the Director of Engineering.

  The Town shall remove sight distance obstructions located within Town right of way. The Town will notify the NCDOT of sight distance obstructions located within their right of way. The Town shall provide written notification to the owner(s) of private property on which a sight distance obstruction exists. The property owner(s) shall be responsible for the prompt removal of the obstruction on their property, and may be liable for any damage resulting from their failure to remove the obstruction.

  In addition, intersection sight distance is based on conflicts with opposing vehicles rather than with objects located in the roadway. Intersection sight distance is measured in the horizontal (plan) and vertical (profile) planes. In both situations, a driver must be offered an unobstructed line of sight to the roadway they wish to cross or join.

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

  The horizontal line of sight is a visual line connecting the driver's eye and the approaching vehicle, both of which are in the center of the travelway. If this line of sight is impeded by any obstructions, either the obstruction should be moved or the alignment adjusted. The vertical intersection sight distance is measured along the centerline of the major street between the drivers of the two opposing vehicles. The vertical line of sight is a visual line connecting the driver's eye, which is located 3.5 feet above the roadway surface, with the approaching vehicle, which is located 4.25 feet above the roadway surface. If this line of sight is impeded by any obstructions, either the obstruction should be moved or the alignment adjusted.

- Prohibited Obstructions

  The following obstructions are prohibited within intersection visibility triangles:

  - ❖ Hedges and walls higher than 2 feet above the curb level
  - ❖ Fences higher than 2 feet above curb level. However, fences that are able not solid in nature, such as split rail, open weave, or wrought-iron are permitted if they are kept free from plantings and other materials that are more than 2 feet in height.
  - ❖ Signs, except as expressly exempted by the UDO
  - ❖ Structures of any type, including principal and accessory buildings, except as expressly exempted by the UDO
  - ❖ Fountains, statues, garden structures and similar fixtures
  - ❖ Parking and vehicular display areas
  - ❖ In order to achieve adequate sight distance, the applicant may at a minimum be required to dedicate an easement near the entrance and to keep it clear of visual obstructions
  - ❖ Tree (case by case)
  - ❖ Or any items deemed a safety hazard to the traveling public in the opinion of the Director of Engineering

2. Driveways

Parking shall not be allowed within intersection sight triangles. Driveways should be located to avoid obstructing sight triangles.

i. Non-Residential Driveways

Standard concrete driveway aprons shall be used when the ADT for the driveway is less than 300 vehicles.

Street type turnouts shall be used when the driveway ADT is greater than the above listed conditions or when access by larger trucks must be accommodated. A minimum radius of 30 feet shall be used on all streets. Lesser radii may be used for street type turnouts with deceleration lanes. The maximum grade allowed when approaching an intersection is five percent (5%) for the last 30' before the edge of the intersection.

All driveways shall have a minimum width of 20' for one way commercial/industrial, and 26' for two way commercial/industrial.

Non-residential driveways with islands shall be approved on a case-by-case basis by

the Director of Engineering.

Where a non-residential driveway meets a public roadway and signalization is not warranted, a stop bar and stop sign shall be used on the driveway approach. Stop bars must be located 4 feet behind a crosswalk, if present.

ii. Residential Driveways

Residential drives shall be minimum width of 20' (see Detail # T_9.01) and be located a minimum of 10' from the point of tangency of curb radii of street intersections

Developments and or redevelopments shall design the driveway location to not conflict with existing or new catch basin locations.

Where driveway aprons are in sag locations, catch basins need to be installed to alleviate drainage problems. The Town shall not be responsible for the maintenance of residential driveways including aprons.

3. Parking Lots

Parking lots shall be designed to provide safe maneuverability of vehicles. A minimum parking stall dimension of 9 feet by 18 feet shall be provided. Handicap parking spaces shall be a minimum of 8 feet wide with a 5 foot lane adjacent to the space properly marked with signage in accordance with the N.C. Building Code. All parking facilities shall have dimensions per Detail # T_15.01. The measurement of said dimensions shall be to the face of curb, unless a curb stop is employed, in which case that will serve as the end of measurement.

At locations where sidewalk abuts a parking bay which is 18 feet deep, the sidewalk shall be a minimum width of 7 feet.

A minimum pavement structure consisting of 8 inches of ABC stone and 3.0 inches of S 9.5B asphalt shall be used in the travel aisles on parking facilities for multi-family (excluding duplex and triplex) developments, and non-residential developments. Access drives for these facilities shall also meet this minimum pavement standard. A minimum of 6 inches of ABC stone shall be required for parking stalls.

All paved parking facilities shall be striped paint with 4-inch white lines (double application).

On all parking lot facilities, cut and fill slopes shall not begin immediately at the back of curb, instead a minimum 4' shoulder is required behind the back of curb.

4. Fire Lane

Fire Lanes shall be installed and inspected in accordance with the public street requirements and the fire code. The Fire Official shall have the authority to designate fire lanes as deemed necessary for Fire Department access. The requirements for installation of a fire lane shall be subject to the fire code.

Fire lanes shall be a minimum width of 20 feet and shall be properly marked and signed to designate the access as a "FIRE LANE" as specified by the Fire Marshal. The surface of the fire

lane shall be paved with a minimum of 8 inches of ABC stone and 3.0 inches of S 9.5B asphalt.

All fire lanes shall be marked in accordance with one of the following requirements:

- Continuously marked with thermoplastic yellow striping along the fire lane with "NO PARKING FIRE LANE" printed with minimum 8 inch high letters at 40 foot intervals or as directed by the Fire Marshal;

- Continuously marked with thermoplastic yellow curb with "NO PARKING - FIRE LANE" along the fire lane with "NO PARKING - FIRE LANE" printed with minimum 8 inch high letters at 40 foot intervals or as directed by the Fire Marshal;

- The installation of the MUTCD standard sign showing "No Parking - Fire Lane" placed at each end of the fire lane and at 50 foot intervals with arrows on the signs or a continuously painted yellow strip along the designated fire lane.

5. Central Mail Delivery

i. Purpose

In April of 2012, the United States Postal Service (USPS) revised its regulations to clarify options for delivery and to provide the USPS greater autonomy in determining how deliveries are added to the Postal Service network. While curbside and sidewalk delivery remain viable and approved modes of delivery, the USPS determines how and when to approve these modes of delivery. The USPS now allows a new type of mail delivery option referred to as central delivery. The Town has established the following minimum standards in order to achieve the safe, logical placement, and arrangement of central mail delivery in our community.

ii. Central Mail Delivery

The local postal manager will work with builders and developers to determine what the best mode of delivery is for the area prior to establishing or extending delivery service. This will include the review of site and subdivision plans and consideration of lot size and locations of housing relative to existing delivery infrastructure and to customer travel.

Central delivery service in the form of Cluster Box Units (CBU) may be considered for use at one or more central delivery points in a residential housing community.

iii. Cluster Box Unit Requirements

Cluster Box Units (CBUs) may be allowed along both public and private streets and shall adhere to the following design standards:

- Arrangement

  - The location of CBU(s) is preferred to be located outside the public right-of-way and located in a centralized common area(s) of the development. Sufficient off-street parking should be provided to serve the location.

  - Number of parking spaces shall be per table below:

Number of Mailboxes per Location	Minimum Number of Parking Spaces
100 or less	3
101 – 200	4
201 or more	5

  - CBU(s) with **13** or less mail receptacles may be located along a street, other than collector or thoroughfare, between the back of curb & sidewalk, provided all of the following are met:

    - Posted speed limit on street is 25 mph or less.

    - Sidewalk must be located on the same side of the street as the CBU.

    - Access to the mailbox by the residents must be from the sidewalk side and not the street side of the CBU.

  - CBU units or combination of **26** or less mail receptacles may be located along a street, other than a thoroughfare, provided a separate pull-off area is provided and all of the following are met:

    - Posted speed limit on the street is 30 mph or less.

    - Sidewalk must be located on the same side of the street as the CBU.

    - Access to the mailbox by the residents must be from the sidewalk side and not the street side of the CBU.

    - A separate pull-off or parallel parking area is provided with an appropriate amount of parking spaces.

  - CBU units shall not be located adjacent to street side trails.

  - The Town will work with developers and USPS for suitable and safe locations within the street right-of-way for streets without curb and gutter and sidewalk.

- Location

All cluster style mailboxes must be erected:

- ❖ No case closer than 100 feet measured from the curb-line of the intersecting streets.
- ❖ Away from any location whereby reason of the position of, shape or color, may interfere with or obstruct the view of, or be confused with any authorized traffic sign, signal or device.
- ❖ So as to not obstruct sight distance along the roadway and at intersecting streets, major driveways, or greenway trail facilities.
- ❖ No closer than 10 feet away from a residential driveway serving a detached, semi-attached or townhome dwelling.
- ❖ In common areas or near property lines rather than directly in front of a residence.
- ❖ Outside of public utility easements, private storm drainage easements, and at least 10 feet away from water meters and cleanouts.

- Lighting

  When lighting plans are being developed, CBU locations that may have been previously developed during site or subdivision plan approval should be considered to ensure that suitable and sufficient lighting can be provided to the CBU locations.

- Signs & Markings

  In areas where parking is provided for CBU(s), permissible parking signs shall be installed on both ends of the defined parking area and designated specifically for mail parking. Signs R7-21a, shall be used that states "MAIL PARKING, 15 MINUTE LIMIT". Reserved accessible spaces shall be clearly marked with an international accessibility symbol marked on the pavement and signs R7-8 and R7-8a installed. All pavement markings and signs shall be in accordance with the Manual on Uniform Traffic Control Devices (MUTCD).

- Maintenance

  The Town does not have any responsibility for mail delivery; therefore, the Town does not own or maintain CBU(s) but does allow CBU(s) as an allowable encroachment in Town's right-of-way.

- Snow and Trash Removal

The Town will not be responsible for clearing snow and accumulations from the sidewalk, designated parking areas (if applicable), and pad around the CBU. In addition, the area around the CBU(s) is to be kept clean from trash and debris and clear from any obstacles that could impede mail delivery or retrieval. These responsibilities must be provided by mailbox users or a homeowner's association.

- Signs on CBU

  Signage affixed to CBU(s) is prohibited.

- Construction of CBU

  Materials and specifications for the installation of CBU(s) and concrete pads are to be in accordance with USPS requirements and their approved manufacturer list.

iv. Exceptions

The Director of Engineering has authority to grant modifications to the design requirements upon collaboration and concurrence with the local postal manager.

F. Materials

Portland cement concrete for curb and gutter, driveways, and sidewalks shall have a minimum 28 day compressive strength of 3600 psi, a non-vibrated slump between 2.5 and 4 inches, a minimum cement content of 564 pounds per cubic yards, an air entrainment of between 5 and 7%, and a maximum water-cement ratio of 0.532. (Also see Sec. 2.07 "Concrete")

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

Concrete Curing Agents shall be free from any impurities which may be detrimental to the concrete and meet Section 1026 of the NCDOT Standard Specifications.

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

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

Water for mixing or curing the concrete shall be free from injurious amounts of oil, salt acid, or other products injurious to the finished product.

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

Superpave – Asphalt Concrete Surface Course, Type SA-1, S4.75A, S9.5A, S9.5B, S9.5C, S9.5D shall consist of a mixture of coarse and fine aggregates, asphalt cement, and shall meet the requirements in Sections 609 and 610 of the NCDOT Standard Specifications.

Superpave – Asphalt Concrete Intermediate Course, Type I19.0C, shall conform to the general, material, and construction specifications of Section 609 and Section 610 of the NCDOT Standard Specifications.

Superpave – Asphalt Concrete Base Course, Type B25.0C, shall conform to the general, material, and construction specifications of Section 609 and Section 610 of the NCDOT Standard Specifications.

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

Asphalt Crack Sealant shall consist of a hot pour asphalt rubber (PS/AR Sealant) that shall meet the general, material, and construction specifications of Section 657 of NCDOT Standard Specifications.

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

Concrete Pavers may be used on privately maintained streets. The Town will not maintain decorative type paved street surfaces such as pavers or imprinted designs within public right of way.

Geotextile Fabric may be used to stabilize roadways, subgrades, slopes, and for other uses as necessary. The material must be submitted to the Town by a licensed professional engineer (NC) and be reviewed and approved by the Director of Engineering prior to installation. Areas stabilized with fabric shall be indicated on "as-built" drawings with the manufacturer name and type fabric indicated.

Prismatic Sheeting shall be a micro-prismatic lens reflective sheeting, classified using ASTM D4956-17. Sheeting types to be used are ASTM Type III, IV, and VI-X.

G. Construction and Inspection

1. Streets

No base material shall be placed on a roadway until the storm sewer, subgrade, utilities, and all appurtenances have been inspected and approved by the Town's Representative. A written approval from Union County Public Works will also be required.

The Town's Representative will require field density testing of the subgrade soils by a certified testing firm. Field density tests shall be per NCDOT standards. The firm shall perform sufficient Proctors to evaluate the compaction characteristics of various soils used in the roadbed. The Town's Representative will also require field density testing of the ABC used and an asphalt mix formula before either is inspected or approved.

Inspection of the subgrade prior to placement of base course, and inspection of the base course prior to placement of asphalt shall be performed by proof rolling at the direction of the Town's Representative. Proof roll shall be conducted with a loaded tandem axel dump truck with 20 tons loaded on truck. Weight ticket will be required to be submitted to the Town's Representative

before operation begins.

Only lap joints are allowed. All pavement edges shall be saw cut to provide a good longitudinal joint. Mill a minimum 1.5 feet of existing pavement to 1.25 inches deep to minimum to provide a lap joint for final surface layer at all existing asphalt tie-in locations. No milling shall be left for a period of time greater than 48 hours before a street is to be paved/resurfaced.

All pavement remediation methods (such as full depth recycle, pavement stabilization, etc.) shall be designed by third party geotechnical firm and be approved on case-by-case basis by Director of Engineering.

2. Curb and Gutter, and Sidewalks

No concrete shall be placed until the forms and subgrades have been approved by the Town's Representative.

The surface of sidewalks shall be finished to grade and cross section with a float, trowelled smooth and finished with a broom. Sidewalks must be satisfactorily installed before issuance of CO.

- Subgrade shall be excavated to the required depth and shaped to the proper cross-section. Where tree roots are encountered, they shall be removed to a depth of 1 foot for the full width of the excavation. The subgrade shall be stable and thoroughly compacted.

- Forms shall be set and maintained true to the required lines, grades, and dimensions. Forms shall be constructed with material of such strength and rigidity to prevent any appreciable deflection between supports. Straight forms shall be within a tolerance of 1/2 inch in 10 feet from a true line horizontally or vertically. Forms shall be thoroughly cleaned of all dirt, mortar and foreign material before being used. All inside form surfaces shall be thoroughly coated with commercial quality form oil.

- Grooved Contraction Joints shall be cut to a depth equal to at least 1/3 of the total slab thickness. The joint shall be no less than 1/8 inch in width and cut at intervals equal to the width of the sidewalk.

- Expansion Joints shall be a 1/2-inch joint filled with joint filler and placed between all rigid objects and placed no farther than 50 feet apart for sidewalks and curb and gutter, extending the full depth of the concrete with top of the filler 1/2 inch below the finished surface.

- Minimum Widths for sidewalks shall be six (6) feet along public right-of-way. Sidewalks shall not be placed adjacent to the back of curb unless prior approval from the Director of Engineering. Approval for this shall be submitting in writing to the Engineering Department. If approved, minimum width of the sidewalk adjacent to the back of curb shall be six (6) feet in width.

III. STORMWATER

A. Design

1. General

All developments will constructed and maintained so that adjacent properties are not unreasonably burdened with surface waters as a result of such developments.

The Town adopted minimum design criteria regarding stormwater design as set forth by the State of North Carolina's Department of Environmental Quality.

2. Stormwater Detention

The purpose of flood control detention requirements is to protect downstream properties from increased flooding due to upstream development. Development or redevelopment creating a total of 20,000 square feet or more of impervious area shall be designed to control the peak discharges from the 2-, 10-, and 25-year, 24-hour storm events to pre-development levels. The emergency overflow and outlet works for any stormwater BMP shall be capable of safely passing a discharge with a minimum recurrence frequency as specified in the Town of Indian Trail Stormwater Design Manual (NCDEQ manual).

Development or redevelopment that proposes to use existing detention facilities shall comply with the requirements of this Article.

Detention facilities shall not be located within FEMA Special Flood Hazard Areas, drainage areas where the 100-year storm event is greater than 50 cfs, or within 10 feet of any property lines. Design of detention facilities shall be consistent with the Town of Indian Trail Stormwater Design Manual except as stated herein.

Stormwater detention design must be performed by a North Carolina Registered Professional Engineer.

All stormwater detention and water quality facilities with embankments that are designed to hold water shall comply with the Town's Embankment Requirements (Appendix 9) and North Carolina Dam Safety Law.

All detention facilities slopes, excluding the forebay, shall be sodded from the bottom of the pond to the top of the berm. Any exceptions shall be approved by the Director of Engineering.

3. Downstream Impact Analysis

i. Hydrologic Analysis

The Owner shall cause a downstream hydrologic analysis to be performed to determine if there are any additional impacts in terms of peak discharge increase or downstream flooding due to the difference in the pre and post-development 50- and 100-year storm events. The analysis shall be performed at the outlet(s) of the site and downstream at each tributary junction to the point in the conveyance system where the area of the portion of the site draining into the system is 10% of the total drainage area above that point. Key detention structures in the study area must be modeled.

The Owner can choose to forgo the downstream analysis by having their detention to be designed to hold the peak discharges for the 50- and 100-year storm events to pre-development levels.

ii. Hydraulic Analysis

If during the site plan review process the Director of Engineering determines that as a result of an increase in peak discharge between the pre and post-development 50-year storm event, detrimental impacts at thoroughfare culvert crossings are probable, the Owner shall cause a hydraulic analysis to be performed to determine flood elevations for the areas impacted by increased flows. No existing or proposed thoroughfare culvert crossing shall be designed to have stormwater encroach upon the roadway pavement.

If during the site plan review process the Director of Engineering determines that as a result of an increase in peak discharge between the pre and post-development 100-year storm event, detrimental impacts on building footprints are probable, the Owner shall cause a hydraulic analysis shall to be performed to determine flood elevations for the areas impacted by increased flows. No existing or proposed building or habitable structure shall be designed to be flooded or have water impounded against it.

Downstream Impact Analysis must be performed by a North Carolina Registered Professional Engineer and shall comply with the requirements in Appendix 7, "Downstream Impact Analysis".

4. Flood Analysis

All streams in Indian Trail which drain more than one square mile (640 acres) are regulated by Section 1360, "Flood Damage Reduction Ordinance". Streams that drain less than one square mile will also experience flooding and require regulation as well. This regulation is known as the "100 + 1 Flood Analysis". For drainage systems which are expected to carry 50 cfs or more in the 100-year storm event, both the 100-year + 1 Storm Water Elevation Line (SWEL) and the Storm Water Protection Elevation (SWPE) shall be shown on the site, grading plan, and recorded map.

Flood Analysis must be performed by a North Carolina Registered Professional Engineer.

5. Ponds

All plans that include a proposed natural pond, and all plans that include stormwater runoff to any existing natural ponds, shall be subject to the review of the State Dam Safety Engineer. An Evaluation of the pond dam shall be made by the designer, in accordance with the Dam Safety Law of 1967, and submitted to the Dam Safety Engineer for review.

All existing natural ponds proposed to comply with this ordinance and shall be evaluated to verify the ponds will safely withstand the post-development 50-year storm event with a minimum of 0.50 feet of freeboard at the dam. Design calculations shall include the assumption of future build out of the drainage basin.

Where ponds are proposed to be constructed, the owners, heirs, assigns or successors of the land will agree to perpetual maintenance of the pond and will release and hold harmless the Town of Indian Trail from any liability, claims, demands, attorney's fees, and costs or judgments arising from said pond. At a minimum, ponds will be inspected by a North Carolina Registered Professional Engineer on a yearly basis. The annual inspection report will be submitted to the Director of Engineering for purposes of compliance.

6. Additional Development Restrictions

When a detention facility serves more than one property, a permanent detention easement that encompasses the detention facility will be shown on a recorded plat. This easement will be described by metes and bounds.

There will be a note placed on the recorded plat that clearly describes who is responsible for maintenance of the detention facilities, pipes and/or channels located within the permanent detention facility easement.

Deviations from the Town's Stormwater Manual may be necessary to accommodate soil types found in Union County and site constraints subject to approval by the Director of Engineering.

Any additions to a pre-existing development that meets the conditions stated in the Post-Construction Stormwater Ordinance will be subject to the requirements of this section. Demolition of existing structures for purposes of redevelopment will be subject to the requirements of this section.

Minor residential subdivisions and individual single-family residences are exempt from said requirements.

7. Embankment Requirements

i. Fill Materials

The following parameters apply to materials used to construct earthen embankments:

Borrow material shall be classified as ML, MH, SC, SM, CL or CH soils according to the Unified Soil Classification System (ASTM D2487) or any mixture of these soils.

Borrow materials shall have a liquid limit (LL) between 40 and 60 and a plasticity index (PI) between 15 and 30 (ASTM D4318).

Materials shall be free of topsoil, organic or frozen material, roots, stumps, brush, rocks larger than 3.0", subsoil, debris, vegetation, and other foreign matter.

All material clods will be broken down with tillers and/or discs to provide a homogeneous soil that is free of clay clods greater than 3.0" in diameter.

ii. Construction

The following steps apply to construction of an earthen embankment:

- Foundation Preparation

  - ❖ Compact foundation to density requirements for subsequent fill materials.
  - ❖ Cut out soft areas of foundation not capable of compaction in place.
  - ❖ Scarify foundation surface to depth of 6.0".
  - ❖ Proof roll foundation to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

- Seepage Key Placement

  - ❖ Seepage key trench will be located between embankment abutments.
  - ❖ Seepage key shall extend to a minimum depth of 4.0' or as required through geotechnical seepage analysis. A minimum bottom trench width shall be 10.0' and the trench sidewalls shall be sloped or benched to promote stability and bonding between the sidewall soils and seepage key fill.

- Fill Placement

  - ❖ Earthen embankment fill shall be constructed at 3:1 slopes or as shown on the drawings. Demonstration of appropriate safety factors against failure through geotechnical analysis shall be require for slopes steeper than 3:1.
  - ❖ Fill soils shall be placed in loose lifts not to exceed 8.0" in thickness and be compacted to a minimum of 95% maximum dry density (Standard Proctor ASTM D698) with a moisture content within ±3% of the optimum, unless otherwise specified by the engineer.
  - ❖ Fill soils should be placed in continuous, horizontal layers from abutment to abutment. Existing slopes greater than 4:1 shall be benched to promote bonding of newly placed fill with existing soils. Benching shall be performed at maximum of 2.0' vertical intervals and shall extend a minimum of 4.0' horizontally or as specified on Drawings.

- ❖ Within the upper 12.0" of earthen embankment, fill soils should be compacted to 100% of its Standard Proctor (ASTM D698) maximum dry density.

- ❖ Fill against supported structures. Do not fill against unsupported structures.

- ❖ Place fill simultaneously on each side of unsupported structures until supports are in place.

- ❖ Place a minimum of 6.0" of Planting Mix (Ref City of Charlotte Landscape Construction Standards) across dam embankment to promote vegetative growth.

- Outfall Pipe Fill Placement

  - ❖ Fill of the culverts shall be placed and compacted in 6.0" thick loose lifts around the drop inlets and up to 2.0' above the culverts.

  - ❖ Compaction shall be performed by hand tampers or small hand operated compactors.

  - ❖ Compaction shall be a minimum of 95% maximum dry density (Standard Proctor ASTM D698) with a moisture content within ±3% of the optimum, unless otherwise specified by the engineer.

  - ❖ Additional compaction of lifts 2.0' or greater above culverts shall conform to the Fill Placement section of this specification.

- Field Quality Control

  - ❖ Laboratory Testing

    - o Perform laboratory material tests accordance with ASTM D422, ASTM D698, ASTM D2216, and ASTM D4318.

    - o Test at a frequency of every 500cy of earthen embankment fill material placed, when materials used for embankment fill change, and/or as directed by the Engineer.

    - o Sample size shall be 50-lb.

  - ❖ In-place Compaction and Natural Moisture Content Tests

    - o Perform in place compaction tests in accordance with ASTM D1556, ASTM D2922, or ASTM D2937 and natural moisture content test in accordance with ASTM D2216.

    - o Frequency of compaction/natural moisture content tests:

      Embankment Fill: Each lift at a minimum frequency of 1 per 2,500 sq. ft.

Pipe Installation: Each lift at a minimum frequency of 1 per 30 lf of pipe.

- When tests indicate work does not meet specified requirements, remove work, replace, rework, recompact, and retest.

Allowable Variances

Earthen embankment specifications may be modified based on site-specific geotechnical investigation and engineering design.

References

Charlotte-Mecklenburg BMP Design Manual

City of Charlotte Landscape Construction Standards

ASTM D422 - Standard test Method for Particle-Size Analysis of Soils (Grain Size with Hydrometer)

ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).

ASTM D1556 – Standard Test Method for Density of Soil In-Place by the Sand-Cone Method.

ASTM D2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

ASTM D2487 – Standard Practices for Classification of Soil for Engineering Purposes (Unified Soil Classification System)

ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).

ASTM D2937 - Standard Test Method for Density of Soil In-Place by the Drive-Cylinder Method Test.

ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

8. Retaining Walls

The latest edition of the North Carolina Building Code includes requirements for the design and construction of retaining walls. Specifically, Section 1807.2 states:

Retaining systems providing a cumulative vertical relief greater than 5 feet in height within a horizontal distance of 50 feet or less, including retaining walls or mechanically stabilized earth walls, shall be designed under the responsible charge of the registered design professional. Retaining

systems shall meet the requirements of Section 1610. Testing and inspection reports shall comply with Section 1704.1.2 and shall verify:

Foundation support system is adequate for the intended site conditions;

Measurement of the quantity of construction materials for conformance with specifications;

Determination of similarity of actual soil conditions to those anticipated in design; and

Examination of backfill materials and any drainage systems for compliance with plans and specifications.

i. Requirements

These requirements will apply to all commercial construction, which include retaining walls and grades falling within the criteria described in Section 1806.2. In addition, the Town will apply the criteria to residential projects where retaining walls impact public use or access areas.

Design and submittal requirements:

Option 1:
Submit, as part of the site plan review drawing set, retaining wall drawings, fully designed and detailed, and sealed by a North Carolina Licensed Professional Engineer.

Option 2:
Site plan review drawing set to include location and design criteria (wall height and schematic wall cross section) for retaining walls only, along with the following statements:

- "Design of all retaining walls is to be per North Carolina Building Code Section 1807."
- "Detailed retaining wall design drawings, sealed by a North Carolina Licensed Professional Engineer, will be submitted to the Town prior to construction."
- "A North Carolina Licensed Professional Engineer must perform construction observation, verifying in a sealed letter to the Town that retaining walls are constructed per the engineered drawings."

ii. Construction

Construction of retaining walls may proceed only after detailed retaining wall design drawings, sealed by a North Carolina Licensed Professional Engineer, are submitted to the Town. The Owner's North Carolina Licensed Professional Engineer will perform construction observation.

Upon completion of retaining wall construction, the Engineer will submit 1) a sealed letter to the Town, verifying the retaining walls are constructed per the engineered drawings, in compliance with Section 1806 of the NC Building Code, and 2) a copy of all special inspections reports in accordance with Section 1704.1.3 of the NC Building Code.

Certificates of Occupancy will only be issued after receipt of the Engineer's sealed letter and copy of the special inspections reports.

9. Pipe Location

All public storm drain pipes shall be installed in right of way or public/private storm drainage easements. If storm pipes are installed in an easement, then the following items are:

i. Prohibited

- Trees planted directly on top of the storm pipes
- Swimming pools
- Recreational courts consisting of solid surfaces (ex. Basketball and Tennis Courts)
- Dams or anything built vertically that might impede the flow of water
- Fences (that impede the flow of water)
- Solid retaining walls or barriers
- Sheds or accessory structures
- Permanent structures not intended to be moved, such as walls, decks, and structures made wood, brick, block, concrete, or other solid materials.

ii. Not Prohibited

- Trees (as long as the root system doesn't impact the storm pipe)
- Fences (not made of brick, block, or heavy materials that require footings)
- Shrubs
- Flowers

Minimum easement widths shall be per the tables below:

CLOSED STORM DRAIN PIPE SYSTEMS	
PIPE SIZE	EASEMENT WIDTH
15"	20'
18"	20'
24"	20'
30"	25'
36"	25'
42"	25'
48"	25'
54" & GREATER	30' MIN (VARIES)

OPEN CHANNEL DRAINAGE	
AREA IN ACRES	EASEMENT WIDTH
0 - 45 AC	20'
45 - 120 AC	30'
120 - 500 AC	40'
> 500 AC	SEE NOTE 2

Easements Notes:

1) For open channels the minimum easement must contain the width of the stream from top of bank to top of bank.
2) For streams with a drainage area of 500 acres or more, the easement requirement shall be the width of the stream measured from top of bank to top of bank plus 10' on each side of the stream. The minimum width shall be 40'.
3) Wider easement widths may be required for pipe depths greater than 10'.
4) Pipe systems and open channels on private property shall be placed in a private storm drainage easement.

Horizontal and vertical separation requirements between storm drainage pipe, water lines, and sanitary sewer lines shall be as follows:

i. A 24-inch vertical separation shall be provided between storm drainage pipe and sanitary sewer lines or ferrous pipe materials shall be used.

ii. A 12-inch vertical separation shall be provided between storm drainage pipe and water mains. If a 12-inch vertical separation cannot be maintained, the water main shall be constructed of a ferrous pipe material and a concrete collar shall be poured around the water and storm crossing to immobilize the crossing.

The Town shall maintain only the storm sewer systems within Town maintained right of way, public dedicated drainage easements, and on Town property. All others (proposed or existing private easements) shall be maintained by the property owner(s) or HOA(s).

Discharge points shall be a minimum of 10 feet downhill from the building envelope.

Structures shall be spaced to intercept flow at the uphill turnout of intersections unless the street design provides a continuous downhill grade around the radius and down the intersecting street. Note: a minimum of 2% slope at these locations is required.

Stormwater inlets shall not be placed within travel areas of roadways or parking lots.

10. Pipe Sizing

Systems shall be designed based on rainfall intensities of 4 inches per hour for street inlet spacing, the 2 year storm for side ditches, the 10 year storm for street drainage pipe sizing, the 25 year storm for cross-street drainage, and the 100 year storm for flood plain areas.

Curb inlets shall be spaced to provide a maximum spread of ½ of the outside lane width for the design storm. In areas of heavy pedestrian traffic, the maximum allowable spread may be decreased by the Director of Engineering.

Runoff rates shall be calculated by the Rational Method (for drainage areas less than 2 square miles), SCS Method (for drainage areas greater than 2 square miles), or other acceptable procedure. Runoff computations shall be based on rainfall data published by the NOAA.

Time of concentration (t_c) shall be determined using the Kirpich Equation (Bureau of Reclamation, 1974, p.71), and the storm duration shall equal t_c.

Pipe shall be sized in accordance with the Manning 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.

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 fps during the 2 year storm.

The minimum pipe diameter shall be 15 inches where the inlet is grated and 15 inches where the inlet is not grated.

Pipe shall be installed to provide a true line and grade between structures.

Pipe crossing under roadways shall be perpendicular to the travel lane.

Structures shall be installed at each deflection of line and/or grade.

The maximum length between access points shall be 400 feet for all pipe sizes.

No inaccessible storm drainage structures shall be allowed.

Channels and ditches shall be designed to carry the design flow at nonerosive velocities. Calculations indicating design velocities shall be provided along with typical channel cross-sections. The maximum allowable design velocity in grass channels is 4 feet per second.

A Hydraulic Grade Line (HGL) study shall be performed for all storm drainage systems. The study shall include profiles that show invert slopes, proposed finished grade and hydraulic grade line. Hydraulic grade line shall be required to stay within pipe to ensure no surcharge on system.

Stream crossings requiring greater than double culverts will necessitate a back water study on the 25-year storm.

Limit of two pipe culverts per crossing. Installation shall include box culverts, of no more than two barrels, if requiring greater than double pipe culverts.

11. Pipe Slopes

All pipe slope percentages shall be a minimum of 0.5% slope. The Town shall be notified (prior to installation) if this cannot be achieved due to unforeseen conditions.

B. Materials

1. Pipe Materials

Reinforced Concrete Pipe shall conform to ASTM C76, Table III or Table IV. Joints shall be sealed with a plastic cement putty meeting Federal Specification SS-S-00210, such as Ram-Nek or a butyl rubber sealant.

Aluminized Steel Type 2 Pipe shall be 36 inches in diameter or greater and be bedded and manufactured according to ASTM A 929 (Manufacturing), 760 (Coating), 796 (Structural Design) and 798 (installation).

Corrugated Aluminum Pipe shall conform to ASTM B744 and design standard ASTM B790. Installation and backfill shall comply with standards ASTM B788 and AASHTO M145. The corrugated aluminum pipe shall meet or exceed HS-20 loading requirements and NCDOT approvals.

High Density Polyethylene (HDPE) Corrugated Pipe shall be used only in areas outside of public right of way and easements. When used in private locations, pipe material shall be rated on approved plans and include the submission of design criteria. Installation of HDPE pipe shall adhere to design criteria standards. Pipe material shall meet the product specifications of AASHTO M294 "Corrugated exterior/smooth interior pipe (Type S)". Pipe joints shall consist of an integral bell and spigot type joint with "O" ring rubber gasket meeting ASTM F477 placed on the spigot end. At least two (2) corrugations of the spigot end must insert in the bell end. Installation shall adhere to the specification of ASTM D2321 and certified by an engineer. HDPE pipe, 24" or smaller may be used under pavement or curb and gutter in private development only.

Polyvinyl Chloride (PVC) Pipe shall be used only in areas outsideof public right of way and easements. When used in private locations, pipe material shall be rated on approved plans and include the submission of design criteria. Installation of PVC pipe shall adhere to design criteria standards. Pipe material shall meet theproduct specifications of ASTM F949-93a and shall have a smooth interior. PVC pipe, 24" or smaller may be used under pavement or curb and gutter in private locations only.

Polypropylene Pipe (PP) is allowed to be installed outside and inside all public right-of ways and easements along local and commercial roadways. The only exception is inside the public right-of-way of minor and major thoroughfares. These heavily traffic thoroughfares will be approved on a case-by-case basis. This pipe shall conform to AASHTO M330 or ASTM F2881 "corrugated exterior/smooth interior pipe (Type S)". Pipe joints shall consist of an integral bell and spigot type joint with "O" ring rubber gasket meeting ASTM F477 placed on the spigot end. Bells shall cover two (2) full corrugations on each section of pipe. Joint performance shall meet the watertight joint performance requirements of ASTM D3212. All pipes shall be clearly marked in the factory showing the AASHTO or ASTM designation, date of manufacture, and name/trademark of the manufacturer. Installations shall adhere to the specifications specified in Detail #SW_15.01 and certified by an engineer. Testing requirements for this particular pipe shall be the following:

1) Mandrel testing
2) Pipe videoing or ASTM F1417
3) Letter from Engineer of Record stating all tests have passed and pipe installed per Town's and manufacturer's requirements.

2. Structure Materials

All storm drainage structures such as manholes, inlets, junction boxes and catch basins shall be constructed of either solid brick, solid block, or precast concrete.

Clay Brick shall be solid, rough, sound clay brick conforming to ASTM C32, Grade MS. The brick shall be laid with full shove joints, filling up the joints with mortar. The thickness of the joints shall not exceed 3/8 of an inch.

Concrete Block or brick shall be solid and conform to ASTM C139 as to design and manufacture. The block or brick shall be embedded in a mortar bed to form a 1/2 inch mortar joint.

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

Manhole Frames and Covers shall be cast iron and meet the ASTM requirements set forth in the latest edition of the NCDOT "Standard Specifications for Roads and Structures" and the dimensional requirements set forth in the latest edition of the NCDOT"Roadway Standard Drawings #840.54". Grate shall be stamped with the NCDOT specification number as evidence of satisfying the above requirements.

Steps shall be provided in all drainage structures over 3'-6" in depth and shall meet the material, strength, and installation requirements as specified by NCDOT Standard Detail 840.66.

Headwalls and Endwalls may be constructed in accordance with NCDOT details, or precast concrete with wing walls and apron by an approved manufacturer. Installation of precast headwalls and endwalls shall be in accordance with the manufacturer's recommendations.

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

3. Installation

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

A reinforced concrete slab designed by an engineer may be used at oversized structures to adjust an inlet to standard dimensions. They must meet H-20 loading.

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

The minimum cover for storm sewer pipe shall be 1-foot to finished subgrade under roads and 2-foot to finished grade in non-load bearing areas. Trench excavation and backfilling shall be in accordance with the requirements below unless more stringent installation requirements are listed with specific material type and certified by an engineer.

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

Each drainage structure shall have an invert constructed from concrete and shaped to conform with the pipe ID, and a bench with a maximum 5:1 slope. The bench shall begin at a height of one-half the pipe diameter for 15 to 24 inch pipe, one-third the pipe diameter for 30 to 48 inch pipe, and one-fourth the diameter for pipe greater than 48 inches in diameter. Precast headwalls and endwalls shall only be installed at single pipe culverts.

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

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

4. Trenching

i. Trenching Dimensions

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

Open trenches shall not exceed 100-ft.

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

All trenches along roadways, and otherwise as directed by the Town's Representative, shall be properly backfilled at the end of each working day.

ii. Trench Protection

Wet trenches shall be stabilized with a base layer of #78 M or #57 stone. The bottom of the trench shall be shaped to provide uniform support along the entire length of the pipeline. Severely unstable trench bottoms requiring undercut excavation shall receive a foundation support system for the pipeline designed by a registered Geotechnical Engineer licensed in the State of North Carolina.

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

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

5. Inlets and Outlets

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

Flared end sections shall be installed on single pipe culverts up to and including 60 inches in diameter, and on multiple pipe culverts up to and including 36 inches in diameter.

Headwalls and endwalls shall be installed on single pipe culverts greater than 60 inches in diameter, and on multiple pipe culverts greater than 36 inches in diameter.

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

A fabric barrier shall be installed between dissipation pads andthe natural ground.

The system shall include scour protection for drainage ways.

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

Additional information on the impact of stormwater discharge onto adjacent properties may be required by the Town.

C. Inspection and Testing

1. Visual Inspection

All materials used must be approved by the Town's Representative prior to installation.

Rejected materials shall be immediately removed from the job.

Storm drain lines shall be clean and free from obstruction and shall be visually inspected from every structure or opening. Lines which do not exhibit a true line and grade or which have structural defects shall be corrected.

All piping and structures must be approved by the Town's Representative prior to paving.

IV. SPECIFICATIONS AND SPECIAL PROVISIONS

A. Asphalt

All asphalt used in the construction of a project shall consist of all elements covered by Section 610 of the Standard Specifications.

All asphalt binder for plant mix used in a project shall consist of all elements covered by Section 620 of the Standard Specifications except for adjustments in price.

All roadways shall have only one (1) longitudinal joint which is located along its centerline.

All cost associated in raising utilities (sewer manholes, water valve boxes, etc.) or removal/hauling away existing asphalt during paving operations shall be included in the unit price bid for Asphalt.

All work associated in the adjustment of utilities shall be in accordance with Section 858 of the Standard Specifications.

B. Asphalt Concrete Plant Mix Pavements

Description: The work covered by this special provision consists of all elements of work covered by Section 610, "Asphalt Concrete Plant Mix Pavements", including all work items listed below:

Miscellaneous Asphalt Removal/Disposal, the Contactor shall remove and dispose of miscellaneous asphalt (existing driveways, streets, pads, slabs, wheelchair ramps, walks etc.) This also includes any concrete that's not curb or sidewalk.

All work pertaining to roadway excavation besides asphalt milling.

Removal and resetting of mail boxes, signs and site amenities: the Contractor shall remove, protect, and reset mailboxes, signs and site amenities that are within the construction work limits. The Contractor shall keep mailboxes in service at all times.

Removal and proper disposal existing drain pipes, trees, tree roots, shrubbery, structures, or any other foreign materials not associated with the overall appeal of the site.

Proper relocation and maintenance of street signs impacted by a project. The Contractor shall keep signs in service at all times.

Protection, maintenance, repair, and or replacement of all property corners: the Contractor will be responsible for protecting the integrity of all property corner monuments. Any property corners damaged during the construction of the project will be properly mitigated to the satisfaction of the Town.

All disturbed areas shall be reestablished with fertilizer, limestone, and seed sown with straw or coconut matting used to cover the entire repaired area. Any existing plantings in the immediate area of the work shall be mulched with a minimum of four (4) loosely placed inches of new, clean, pine straw. Sod will be used when property has preexisting established sod that has been damaged by the Contractor.

Methods and Materials: Construction Methods will be per Section 610, "Asphalt Concrete Plant Mix Pavements" of the latest addition of the NCDOT Standards Specifications and items described above.

C. Asphalt Plant Mix, Pavement Repair

Unless otherwise shown in the plans, details, or as directed by the Engineer in the field, all asphalt street repairs will consist of digging out a minimum 4" depth specified area and replacing it with Intermediate Course (I 19.0 B) and topped with Surface Course (S 9.5B). For street repairs exceeding 5" depth, Base Course (B 25.0B) may be incorporated as approved by the Engineer. If the repaired area is not topped with Surface Course (S 9.5B) in a suitable time frame, the area in question will be inspected again and if found to be unsuitable the Contractor will replace the area at no cost to the Town.

D. Sawing Existing Pavement

Where asphalt or concrete (curb, sidewalk, roadway, driveways, parking lots, etc.) is to be removed, the Contractor shall provide a neat edge along the pavement being retained by sawing the pavement a minimum of 2" deep, a maximum of 1/8" thick, and minimum 1' wide before breaking and removing adjacent pavement.

When the Contractor proposes to saw pavement more than one foot from the proposed pavement (curb, sidewalk, structure, etc.), the Contractor shall obtain approval from the Engineer prior to saw cutting and removing pavement.

This includes work on existing streets that have been repaired by Full Depth Reclamation.

E. Concrete

1. Compressive Strength

All concrete used in the construction of a project shall be 3600 PSI strength at twenty-eight (28) days, unless otherwise specified. No adjustment will be allowed for the required use of high-early strength concrete. When the Contractor is requested to use high-early strength concrete in certain areas, he must furnish a copy of the delivery ticket to the project inspector prior to allowing traffic to proceed across the item in question before the required seven daycuring period. Concrete cylinders shall be prepared by the Town's designated materials testing firm. It shall be the responsibility of the Contractor to protect the cylinders until such time as they are taken to the designated materials testing laboratory. Not less than five (5) cylinders (six (6) for structures) shall be made for each day's pour.

2. Slump

The maximum slump of the concrete used on the project shall be as defined in Section 1000 of the Standard Specifications. The Town's designated testing firm shall provide all equipment necessary to test the slump of the concrete and at a frequency established by the Engineer and in accordance with ASTM C 143. The sample taken for determination of slump will be obtained immediately prior to the concrete being discharged onto the project. Concrete failing to meet requirements for slump will be subject to rejection.

3. Air Content

The air content of the concrete used on a project shall be as defined in Section 1000 of the Standard Specifications. The Town's designated testing firm shall provide all equipment necessary to test the air content of the concrete and shall test the air content at a frequency established by the Engineer. The sample taken for the determination of air content will be obtained immediately prior to the concrete being discharged onto the project. Concrete failing to meet specification requirements for air content will be subject to rejection.

4. Acceptance and Testing Standards

Concrete batching, sampling, testing and evaluation shall be done in accordance with the standards listed below:

ASTM C94	Standard Specifications for Ready Mixed Concrete
ASTM C17	Standard Method of Concrete Sampling
ASTM C470	Tentative Specification for Molds for Forming Concrete Test Cylinders Vertically

ASTM C31	Standard Method of Making and Curing Concrete 67
ASTM C143	Standard Method of Test for Slump of Portland Cement Concrete
ASTM C42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
AASHTO T199-72	Air Content of Freshly Mixed Concrete by the Chace Indicator
ASTM C231-82	Standard Test for Air Content of Freshly Mixed Concrete by the Pressure Method

5. Concrete Finishes

The type of finish required will be that required by the section of specifications directly applicable to the work being constructed. All exposed surfaces of retaining walls, structures, etc. shall be given a Class 2 finish as described by Section 420-18 (f) of the Standard Specifications unless indicated otherwise in the plans.

6. Compressive Strength Quality Assurance for Incidental Concrete

The following Quality Assurance Specifications shall apply only to incidental concrete used in the construction of a project. Incidental concrete shall be defined as any concrete not used in the construction of rigid pavement or any concrete that is not an integral part of a structure. The acceptability of any questionable structural concrete used in the construction of a project will be evaluated on a case-by-case basis. It is the intent of these specifications to provide an equitable means of accepting materials that may vary slightly from the specification range stated in the Standards Specifications in lieu of total rejection, removal, repair or non-payment.

The Engineer will determine acceptability of materials in accordance with the applicable sections of these specifications. When materials are not within specification limits, an adjusted payment may be allowed as delineated in these specifications, except where the level and variability of test results indicate a degree of noncompliance with requirements so great as to make the material unacceptable. Unacceptable material shall be either re-worked or replaced at no additional cost to the Town. The Engineer reserves the right to reject questionable material at any time in lieu of making reduced payment.

Concrete will be tested and accepted with respect to compressive strength on the basis of the average test results of concrete test cylinders. It shall be the responsibility of the Owner's/Developer's designated testing firm to prepare test cylinders in accordance with ASTM C31. It shall be the Contractor's responsibility to adequately protect the cylinders until such time as they are taken by the designated testing firm to an approved Materials Laboratory for curing and testing. If the average strength of concrete cylinder test results fail to attain the specified minimum compressive strength at twenty-eight (28) days but meets or exceeds 70% of the minimum compressive strength, the Engineer will have the option of instructing the Contractor to replace all concrete represented by those cylinders with concrete meeting specifications or of allowing the concrete to remain in place at a reduced contract price. The contract unit price for such concrete left in place shall be reduced by the following formula:

Reduced Unit Price = Contract Unit Price X Avg. Strength of Test Cylinders at 28 Days

Specified min. Compressive Strength

In the event that concrete cylinder tests fail to meet minimum compressive strengths at twenty-eight (28) days, the Contractor will have the option of taking cores from the concrete in question at the Contractor's expense. Cores must be taken and tested in accordance with ASTM C42. The average compressive strength of cores which are correctly tested shall then be used as the basis for acceptance of concrete in lieu of concrete test cylinder results discussed above.

The above criteria for acceptance of concrete with respect to compressive strength shall then be applied to core test results. Cores must be taken thirty-one (31) days after placement of concrete. Cores will be tested by the Owner's/Developer's designated testing firm. A minimum of three (3) cores shall be taken from questionable concrete, unless otherwise specified by the Engineer. Cores shall be taken from locations selected by the Engineer.

If the average strength of the concrete test results (cylinders and cores) fail to attain seventy percent (70%) of the specified minimum compressive strength at twenty-eight (28) days, all applicable concrete shall be rejected.