Town of Lillington
Standard Roadway, Sidewalk, Curb & Gutter, & Drainage Pipe Specifications

The following standards are for the construction of roadways, sidewalks, curb, gutter, and storm drainage within the Town of Lillington. All improvements (private and public) shall be designed and fully constructed to the Standard Specifications and in accordance with all ordinances and policies of the Town. NCDOT standards shall be used on all existing State roads, extensions of existing State roads, or roads to be maintained by NCDOT. Refer to Standard Specifications for Roads and Structures as published by the NCDOT and Roadway Design Manual as published by the NCDOT. Developers and/or Contractors shall adhere to the standards set forth herein for all improvements (with the exception of NCDOT roadways) constructed within the jurisdiction of the Town of Lillington.

A. The Developer and/or Contractor shall adhere to any and all conditions set forth including the widths, length, configuration, other features and appurtenances defined on the approved preliminary plan and construction drawings. No deviation from the approved plans and the standards indicated herein shall be allowed without the expressed written permission of the Town of Lillington or their authorized representative.

Roadways

Sub-grade Preparation:

General:

a. After the earthwork has been substantially completed and related work has been completed, the sub-grade shall be brought to the lines, grades, and typical cross-section shown on the plans, and finished in accordance with these specifications.

b. The sub-grade shall be properly shaped and thoroughly compacted so that it conforms to the lines and yielding condition before any base course or curbs and gutters are placed thereon. If the sub-grade does not contain sufficient moisture for compaction, it shall be wetted to optimum moisture content.

c. All soft and yielding material, boulders, loose stones or any other unsuitable material in the sub-grade which will not compact readily shall be removed and replaced with suitable material which shall be thoroughly compacted. All submerged roots, stumps, or other perishable matter encountered in the preparation of the sub-grade shall be removed.

d. In preparing the sub-grade, the material excavated shall not be piled outside and along the forms in such a manner as to interfere with the proper operation of the finishing of curbs and gutters or the proper drainage of the sub-grade.

1. Proof-Rolling of Sub-grade: The subgrade shall be proof-rolled as required by the Town for the entire length of the project by using a fully loaded tandem dump truck with a minimum gross weight of 56,000lbs. A qualified representative of the Town shall be present during proof-rolling sub-grade. The Contractor shall give the Town at least 48-hours' notice in writing. Proof-rolling shall be pre-tested by the Contractor prior to Town inspection. A current weight ticket shall be

provided to the Town at the time of inspection. During the rolling of the sub-grade, the surface shall be maintained smooth by blading or other approved means. Rolling shall be continued until the sub-grade has been compacted throughout to its maximum practical density as determined by the Town. A density of at least 95% Standard Proctor Maximum Dry Density of optimum moisture content shall be obtained in accordance with ASTM C-698 as amended. Any portion of the sub-grade inaccessible to rolling operations shall be thoroughly compacted with hand or mechanical tamps. Should any "pumping" or displacement be observed during the proof-rolling, the defective area(s) shall be repaired by replacing defective material with suitable material, alternative stabilization methods such as fabric, Geo-Grid, lime, etc., or any combination thereof to the satisfaction of the Town, and thoroughly compacted. The proof rolling shall be repeated until there is no evidence of "pumping" or displacement. Stone base course shall be placed within 48 hours of the proof-roll or the proof-roll shall be redone. The proof-roll shall also be redone if rain occurs prior to the placement of stone base course.

2. Geotextile Fabric may be used to stabilize a roadway, subgrades, slopes, and for other uses as necessary. At least one week prior to using this fabric, a sample and its associated engineering data shall be submitted to the Town for approval. Areas stabilized with fabric shall be indicated on "as-built" drawings with the manufacturer name and type of fabric specified.

3. Upon completion of the proof-rolling, the Contractor shall furnish to the Town of Lillington or their authorized representative a report from a certified soil testing laboratory. The report shall present the results of a Proctor analysis demonstrating that the subgrade compaction is acceptable in accordance with standard requirements of NCDOT in all of the significant fill areas. The cost of laboratory testing of subgrade compaction shall be borne by the Contractor. The subgrade shall then be inspected by the Town of Lillington or their authorized representative with a level or string line to ensure that the prepared subgrade has been constructed to the proper grade and transverse slope. Upon its acceptance and approval, the stone base course may be placed. However, no stone base shall be placed prior to backfilling behind the curb.

4. Protection of Sub-grade: Ditches and drains shall be provided and maintained to satisfactorily drain the sub-grade. In no case shall any base course or curbs and gutters be placed on frozen or muddy sub-grade. Frost crystals or mud caused by freezing and thawing shall be removed and replaced with suitable material or allowed to dry before placing any base course or curb and gutters. If ruts are formed in the prepared sub-grade, the sub-grade shall be scarified and thoroughly compacted.

Aggregate Base Course

1. Description of Work: Work under this section consists of the construction of an aggregate base composed of approved aggregate materials hauled to the roadway area, placed on the prepared sub-grade, compacted, and shaped to conform to the lines, grade, depths, and typical cross-sections indicated on the approved construction plans. The standard depth for aggregate base course in the Town of Lillington is 8-inches, unless otherwise approved by the Town.
2. Quality Assurance:

    a. The source and type of aggregate base course shall be approved by the Town prior to placement. If requested, samples of the materials shall be submitted to the Town for approval.

    b. The Town reserves the right to require that quarry tickets be presented to the Town of Lillington or their authorized representative to enable a check for yield at the specified final thickness. Inspection of the base course prior to placement of asphalt shall be performed by proof-rolling and/or field density testing at the direction of the Town of Lillington or

their authorized representative, and also inspection with a level or string line to ensure that the prepared base course has been constructed to the proper grade and transverse slope. Asphalt shall be placed within 48-hours of the proof-roll, or the proof-roll shall be redone. The proof-roll shall also be redone if rain occurs prior to the placement of asphalt. Upon acceptance and approval, the bituminous surface course may be placed.

c. Proof-rolling shall be pre-tested by the Contractor prior to Town inspection.

d. Aggregate base course shall consist of crushed stone or crushed gravel and shall conform to the requirements of Section 520 of the latest edition of the N.C. Department of Transportation Standard Specifications for Roads and Structures as amended.

3. Hauling and Placing Materials:

   a. The aggregate material shall be placed on the sub-grade to the specified depth and in such a manner as to prevent segregation. Where the required compacted thickness of base is 8" or less, the base material may be spread and compacted in one layer. Where the compacted thickness is more than 8", the base material shall be spread and compacted in two or more lifts approximately 4" to 6". Each layer of material shall be compacted tested, and approved before placing succeeding layers of base material or pavement.

   b. No material shall be placed on frozen sub-grade or base. Hauling equipment shall not be operated on sub-grade or a previously completed layer of base material soft enough to rut or weave beneath the equipment. The maximum speed of trucks traveling over any part of the sub-grade or base shall be 20 miles per hour.

   c. The Contractor shall utilize methods of handling, hauling, and placing material which will minimize segregation and contamination. If segregation occurs, the Town may require that changes be made in the Contractor's methods to minimize segregation, and may also require mixing in place which may be necessary to correct any segregated material. No additional compensation will be allowed for work of in-place mixing as may be required. Aggregate which is contaminated with foreign materials to the extent the base course will not adequately serve its intended use shall be removed and replaced by the Contractor at no additional cost to the Owner regardless of prior acceptance.

4. Shaping and Compaction:

   a. Immediately after the placing of a layer of the base, the Contractor shall begin machining and compacting the layer. Each layer shall be maintained to the required cross-section during compacting and each layer shall be compacted to the required density prior to placing the next layer.

      Each layer of the base shall be compacted to a density equal to at least 100% of that obtained by compacting a sample of the material in accordance with AASHTO T99. The base material shall be compacted at a moisture content which is approximately that required to produce the maximum density indicated by the above test method.

      The Contractor shall dry or add mixture to the material when required to provide a uniformly compacted and acceptable base.

   b. The final layer (or top surface for a single layer) of the base material shall be shaped to conform to the lines, grade, and typical sections shown on the approved plans. When completed, the base course shall be smooth, hard, dense, unyielding, and well bonded. A broom drag shall be used in connection with the final finishing and conditioning of the

surface of the base course. After final shaping and compacting of the base, the Town will check the surface of the base for conformance to grade and typical section and will determine the base thickness. The thickness of the base shall be within a tolerance of plus or minus 1/2" of the base thickness specified. The minimum thickness for roadways constructed within the Town of Lillington shall be 8".

5. Maintenance: Where the base material is placed in a trench section, the Contractor shall provide adequate drainage through the shoulders to protect the sub-grade and base until such time as the shoulders are completed. The Contractor shall maintain the surface of the base by watering, machining and rolling or dragging where necessary to prevent damage to the base by weather or traffic. Where the base or sub-grade is damaged, the Contractor shall repair the damaged area; reshape the base to the required lines, grades, and typical sections; and re-compact the base to the required density.

Asphalt

1. Description of Work:

   a. Work under this section provides for the materials and application of plant mix asphaltic concrete surface course over a suitable base course.
   b. For all subdivision roads to be maintained by the Town of Lillington the grade and thickness of the asphalt paving unless otherwise approved shall be as follows:

Asphalt Multi-Purpose Path	
Aggregate Base Course:	6 – inch
Surface Course:	2 – inch S9.5B

Alley	
Aggregate Base Course:	8 – inch
Surface Course:	2 – inch S9.5B

Cul-De-Sac	
Aggregate Base Course:	8 – inch
Surface Course:	3 – inch S9.5B

Local, Minor, or Marginal Access Street	
Aggregate Base Course:	8 – inch
Surface Course:	2.5 – inch S9.5B

Collector Street	
Aggregate Base Course:	8 – inch
Surface Course:	2.5 – inch S9.5 B

Arterial or Major Street	
Aggregate Base Course:	8 – inch
Surface Course:	2.5 inch – S9.5B

Thickness given is on a compacted basis.

c. The cross section grade shall be ¼-inch per foot beginning at the roadway centerline downward towards the edge of pavement. The longitudinal grade shall be a minimum of 0.4% and a maximum of 6% unless otherwise approved by the Town.

2. Quality Assurance:

   a. Materials shall comply with the standards of the latest edition North Carolina Department of Transportation Standard Specifications for Roads and Structures, and the American Association of State Highway Transportation Officials (AASHTO) as amended.
   b. The Contractor shall submit three (3) copies of certifications that the asphalt pavement materials comply with the specifications herein prior to placement.
   c. The Town of Lillington or their authorized representative may also require field density testing of the asphalt mix formula before it is inspected or approved. Bituminous surface course material shall be placed and compacted in accordance with NCDOT requirements. Copies of delivery tickets shall be furnished to the Town of Lillington or their authorized representative to enable a check for yield at the specified final thickness.
   d. Should there be a question as to the final thickness of Aggregate Base Course or bituminous surface course, the Town of Lillington or their authorized representative reserves the right to require the Contractor to provide random core samples by an independent testing laboratory to demonstrate actual thickness of base and surface courses. A certified testing laboratory shall take core samples and the results shall be presented to the Town of Lillington or their authorized representative. Should the cores reveal insufficient thickness, the Contractor shall provide additional surface course as may be required or shall furnish other remedial measures as may be acceptable to the Town.
   e. The cost of compaction testing and coring work shall be borne by the Contractor.
   f. A qualified representative of the Town shall be present during asphalt paving. The Contractor shall give the Town at least 48-hours' notice, in writing, prior to placement.
   g. The surface course of asphalt shall be placed prior to final plat recordation. A separate 1-year warranty for the asphalt shall be required. Upon installation of asphalt, no additional open cuts of the pavement shall be allowed except under unusual circumstances. In those cases where open cuts are allowed after the placement of asphalt, the asphalt shall be milled a minimum of ten feet on either side of the open cut and new asphalt placed to provide a uniform surface.

B. EXECUTION

1. General: The Contractor shall not construct the surface course on the base course until such time as authorized by the Town.

2. Placement Temperature: The minimum temperature for placement of asphalt shall be as follows:

Mixture Type	Min. Air Temperature	Min. Surface Temperature
SF9.5B	45°F	50°F

   Asphalt shall not be placed during rainy weather, when the sub-grade or base course is frozen or when the moisture on the surface to be paved would prevent proper bond. Do not place asphalt material when the air temperature, measured in the shade away from artificial heat at the location of the paving operation and the road surface temperature in the shade is less than shown in the table above.

3. Transportation and Delivery of Mixtures: The mixture shall be transported from the mixing plant to the point of use in vehicles having tight metal bodies previously cleaned of all foreign materials. When directed by the Town, each load shall be covered with canvas or other suitable

material of sufficient size and thickness to protect it from the weather. Bodies shall be lightly oiled to prevent mixture from adhering thereto. No loads shall be sent out so late in the day as to prevent completion of the spreading and compaction of the mixture during daylight. The mixture shall be delivered at a temperature between 225°F and 325°F and within 25°F of the temperature set at the mixing plant.

4. Placing of Mixture:

   a. The mixture shall be spread by means of a mechanical self-powered paver, capable of spreading the mixture true to the proper line, grade, and crown. It shall be capable of spreading the mixtures, without segregation, to the required grade and confine the mixtures to true lines without the use of stationary side forms.

      The term "screed" includes a "strike-off" device operated by cutting, crowding, or other practical action which is effective on the mixtures at workable temperature without tearing, shoving, or gouging and which produces a finished surface of the evenness and texture specified.

   b. Longitudinal and transverse joints shall be made in a careful manner. Well bonded and sealed joints are required. If necessary to obtain this result, joints shall be painted with hot asphalt cement and heated.

   c. After the base course mixture has been spread and before roller compaction is started, the surface shall be checked and all fat spots and irregular areas removed and replaced with satisfactory material. Irregularities in grade shall be corrected before compacting.

   d. On areas where it is impossible to use mechanical spreading and finishing equipment, the mixture shall be spread and screed by hand. Straight edging and back-patching shall be done after initial compaction while material is still workable.

   e. Contact surfaces of headers, curbs, gutters, manholes, etc., shall be painted with approved asphalt cement just before the base mixture is placed against them. All exposed longitudinal edges of the surface course shall be "set-up" by tamping with a rake or lute at proper height and level to receive the maximum compression under rolling.

   f. The Contractor shall provide and have ready for use at all times enough tarpaulins or covers for use in case of rain, chilly wind, or delay for the purpose of covering or protecting any material dumped but not spread.

   g. Asphalt material shall not be placed at temperatures less than 40°F. Ambient temperature shall be 40°F and rising before placement.

5. Compacting of Surface Course:

   a. After placing, the mixture shall be thoroughly and uniformly compacted with tandem rollers of 8 or 10-ton minimum weighing not less than 250 pounds per inch width of roller tread. Each roller shall be in the charge of a competent, experienced operator and must be kept in continuous operation as nearly as practicable. Rolling shall start longitudinally at the outer edges and proceed toward the center of the pavement, overlapping on successive trips by at least 1/3 the width of the roller. The speed of the roller shall at all times be slow enough to avoid displacement of the hot mixture as a result of reversing. Any displacement shall be immediately corrected. Rolling shall proceed at a rate not in excess of 500 square yards per hour per roller and shall continue until no further visible compaction is obtainable and all roller marks have been eliminated. Rolling shall compact the mixture

to at least 95% of the theoretical maximum density.

b. Rolling shall be started as soon as the mixture will bear the roller without undue misplacement or hairline cracking. Delays in rolling hand-raked mixture will not be tolerated.

c. Asphalt shall be placed within 48-hours of the proof-roll, or the proof-roll shall be redone. The proof-roll shall also be redone if rain occurs prior to the placement of asphalt. Upon acceptance and approval, the bituminous surface course may be placed.

d. The Town may also require field density testing of the asphalt mix formula before it is inspected or approved. Bituminous surface course material shall be placed and compacted in accordance with NCDOT requirements. Copies of delivery tickets shall be furnished to the Town to enable a check for yield at the specified final thickness.

e. When edges are not protected, planks of the same thickness shall be placed adjacent to longitudinal or transverse joints until the surface course is completed. Sections of newly finished pavement shall be protected from traffic until they have become properly hardened by cooling.

Concrete Curb & Gutter

A. GENERAL

1. Description of Work: Work under this section consists of furnishing all plant, labor, materials, and equipment or layout, forming placing, and finishing combination concrete curb and gutter and concrete valley gutter.

2. Quality Assurance: Materials shall comply with the standards of the latest edition North Carolina Department of Transportation Standard Specifications for Roads and Structures, and the American Association of State Highway Transportation Officials (AASHTO) as amended.

A. PRODUCTS

1. Concrete: Concrete shall comply with the requirements, and the aforementioned specifications. Concrete shall have a minimum compressive strength of 3,000 psi.

2. Joint Filler Materials: Joint filler materials shall conform to the requirements of ASTM D-1751 or D-1752 and shall be 1/2" in thickness. Type of joint filler used shall be approved by the Town.

3. Impervious Sheeting: Impervious sheeting for curing shall consist of waterproof paper, polyethylene bonded waterproof paper sheeting, and polyethylene coated burlap sheeting or polyethylene sheeting.

4. Liquid Membrane Forming Compound: Liquid membrane forming compound for curing shall be a white pigmented liquid compound, free of paraffin or petroleum, which shall be approved by the N.C.D.O.T. and/or the American Association of State Highway Transportation officials.

5. Forms: Forms shall be of steel or other suitable material approved by the Town Engineer or the Public Works appointed inspector for all the work. Forms shall be free from movement. Forms shall be held in place by metal pins, not less than 18" in length with fastenings of metal and wedges to insure a correct, rigid setting. Forms shall be of the dimensions required for the

designed cross-section shown on the plans. Dividing plates or templates made of steel with sufficient rigidity to prevent warping and bending shall be used to form contraction joints as indicated.

B. EXECUTION

1. Staking: The Developer and/or Contractor shall be responsible for all location and grade staking for the curb and gutter. Horizontal and vertical locations shall be as indicated on the approved plans.

2. Sub-grade: The sub-grade shall be excavated to the required depth below the finished surface in accordance with the plans to the lines and grades established in accordance with the approved plans. All soft and yielding materials or other unsuitable material shall be compacted thoroughly and finished to a firm and smooth surface. No curb and gutter shall be poured until the sub-grade is approved by the Town. Proof-rolling shall be pre-tested by the Contractor prior to Town inspection.

3. Concrete Production and Delivery: Concrete shall be produced and delivered to the job site in strict accordance with the standards of the latest edition North Carolina Department of Transportation Standard Specifications for Roads and Structures, and the American Association of State Highway Transportation Officials (AASHTO) as amended.

4. Forms: Forms shall be kept in good condition at all times. Any forms which have become out of shape or otherwise unsuitable shall be removed from the work. When set up, the forms shall be set such that the deviation from the line and grade does not exceed 1/4". Dividing plates or templates shall be set plumb and normal to the side forms as required. The forms shall be checked for conformity with true line and grade and any deviations in excess of 1/4" shall be corrected. The Town shall inspect the forms prior to pouring operations.

   Forms can be removed after concrete has cured for 3 days, all forms shall be thoroughly cleaned, oiled, and stored in a manner to maintain them in good condition. With the approval of the Town, the Contractor may use a slip-form concrete curbing machine to place curb and gutter. If, at any time, the Town determines that the machine is not doing satisfactory work, the machine shall be removed and the unsatisfactory work shall be repaired or replaced at the Contractor's expense. Should the case of the problem be remedied, the machine may be put back in use. During the time the machine is not being used, the concreting operations shall be done by using forms.

5. Joints: The curb and gutter shall be constructed in place in uniform sections 10' in length. The joints between sections shall be formed by steel template □" in thickness, of the width and depth of the curb and sufficient to hold its shape, but shall be removed while the forms are still in place.

   Expansion joints of suitable material shall be provided at the points designated on the plans or as directed by the Town. Expansion joints shall be placed at 80' intervals and adjacent to all rigid objects.

6. Placing Concrete: After the forms have been set and checked by the Town, the concrete shall be placed in the forms. After the sub-grade has been moistened, it shall be placed so as not to disturb concrete already in place and in such a manner as to require the minimum amount of lateral movement. As the concrete is being placed, it shall be spaded thoroughly to remove any voids and after the removal of the forms, no honeycomb shall be present. Should any honeycombs be present, the Town shall determine if the concrete should be replaced.

   If the Town of Lillington or their authorized representative decides that the honeycombs are

of a minor nature, they shall be filled with mortar. No mortar shall be applied unless directed by the Town.

Care shall be taken not to upset any forms during the concerting operations. Any concrete showing misalignment due to form movement shall be removed and replaced immediately.

7. Finishing Concrete Surfaces: After pouring the concrete, the surface shall be struck off with a straight edge followed by floating, toweling, and edging. At the proper time, the surface shall be given a light broom finish. All finishing shall be carefully done in a uniform manner by expert finishers. All dividing lines, joints, and edges shall be finished by edging tools to make them sharp and true. Any concrete which is not finished in a proper workmanlike manner will not be accepted. Finished surfaces shall not vary from the required line and grade by more than 1/4" in 10'.

8. Curing: Concrete shall be protected adequately from injurious action by sun, rain, flowing water, frost, and mechanical injury, and shall not be allowed to dry out from the time it is placed until the expiration of the minimum curing, impervious-sheeting curing, or by application of liquid chemical compound, except as specified otherwise herein. Completion of curing shall be initiated immediately following finishing operations. The temperature of the air next to the concrete shall be maintained at not less than 40°F for the full curing period. Concrete shall be protected against freezing for the full curing period specified hereinafter.

   a. .Moist Curing & Mats: The entire surface of the concrete shall be covered with two thicknesses of wet burlap weighing not less than 7 ounces per square yard (dry weight), cotton mats, or other approved material having a high absorptive quality. (The material shall be thoroughly wet when applied and shall be kept clean of any substance which will have deleterious effect on the concrete.) They shall be at least as long as the width of the concrete under construction. During application, the mats shall not be dragged over to provide complete coverage of surface and edges of the concrete with a slight overlap over adjacent mats. These mats shall be left in place no less than 8 hours when they may be removed and curing continued by the straw curing method specified hereinafter, or they may be left in place for a total of 72 hours during which time, they shall be kept wet continuously.
   b. Straw Curing: Within one-half hour after removal of the burlap or other mats used for preliminary curing, the straw curing materials shall be thoroughly wetted and then covered with at least 6" of straw or hay thoroughly saturated with water, the 6" being measured after wetting. If the covering becomes displaced during the curing period, it shall be replaced and re-saturated. It shall be kept continuously saturated for three days and shall be wetted down on the morning of the fourth day, and thereafter shall remain in place for three days. After removal, the covering shall be disposed of as directed, and the concrete shall be cleaned and swept. The covering shall not be burned on or adjacent to the concrete. Straw or hay used for curing shall be clean and free from decayed material.
   c. Impervious - Sheeting Curing: The entire exposed surface shall be wetted thoroughly with a fine spray of water and then covered with impervious sheeting. Sheets shall be laid directly on the concrete surface and overlapped 12" when a continuous sheet is not used. The curing medium shall be not less than 18" wider than the concrete surface to be cured, and shall be securely weighted down by placing a bank of moist earth on the edges just outside the forms and over the transverse laps to form closed joints. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.
   d. Liquid Membrane - Forming Compound Curing: Liquid membrane forming compound shall be applied to restrict evaporation of the mixing water. Seven days following the

placing of the liquid membrane-forming compound shall be considered as the end of the curing period and the basis for determining when joint sealing materials will be placed in joints.

The compound shall be applied immediately after the surface loses its water sheen and has a dull appearance and before joints are sawed. Curing compound shall be agitated thoroughly by mechanical means during use and shall be applied uniformly in a two-coat continuous operation by approved power-spraying equipment. The total coverage for the two coats shall be between 250 and 200 square feet per gallon of undiluted compound. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. An additional coat of the compound shall be applied immediately to areas where the film is defective. Approved covering, other than liquid curing compound, shall be kept readily available for use to protect the freshly placed concrete in the event conditions occur which prevent correct application of the compound at the proper time. Concrete surfaces that are subject to heavy rainfall within three hours after the curing compound has been applied shall be sprayed with two coats of curing compound by the method and at the foregoing coverage at no additional cost to the Owner. Continuity of the coating shall be maintained for the entire curing period and any damage to the coating during this period shall be repaired immediately.

9. Removing Form: Forms shall not be removed from freshly placed concrete until it has set for at least 12 hours. They shall be carefully removed and in such a manner as to prevent damaging to the edges of the concrete. Any honeycombed areas along the side shall be filled promptly with mortar composed of one-part cement and two parts of fine aggregate.

10. Cold Weather and Night Concrete: Concrete shall be done when weather conditions are favorable unless otherwise directed by the Town. Concrete operations shall be discontinued when a temperature of 40□F is reached on a falling thermometer and may be continued when temperature reaches 40□F on a rising thermometer. No concreting shall be attempted when local weather bureaus indicate temperatures below freezing within the ensuing 24 hours unless proper precautions are made to protect concrete by covering with straw or other precautions are taken satisfactory to the Town. The Contractor shall be responsible for the quality and strength of the concrete laid during cold weather, and any concrete damaged by frost action or freezing shall be removed and replaced as directed by the Town at the Contractor's expense. No more concrete shall be laid than can be properly finished and covered during daylight, unless adequate artificial lights satisfactory to the Town are provided.

11. Protection of Concrete: Immediately after the forms have been removed and all honeycombed areas repaired, the back of the curb shall be backfilled to prevent under-wash. Traffic shall be excluded from crossing the concrete for a period of approximately 14 days by erection and maintenance of suitable barricades. Contractor shall be responsible for any damage resulting from traffic within the 14-day period, and Contractor shall remove and replace any damaged concrete as directed by the Town.

STORM DRAINAGE

1 Design

A. General

Storm drainage facilities shall be designed in accordance with the Town of Lillington (TOL, Town) goals and guidelines set forth in the Unified Development Ordinance. The goal shall be to collect and dispose of storm water generated upon or passing through the project location. The determination of the quantities of water that must be accommodated will be based upon peak flows from storms having the following return frequency:

Drainage Structure	***Design Storm Event - Return Frequency***
Open Channels/Roadside Ditches	10-year storm
Curb Inlet and Gutters	2-year storm
Storm Sewer Collector	10-year storm
Cross Street Storm Drainage	25-year storm *
Detention Facility	100-year Emergency Spillway
SCM Devices	UDO & NCDENR

* Roadways in flood plain areas shall withstand the 100-year storm without over-topping or sustaining damage. The roadway embankments shall be fully protected from flows that may occur during a 100-year event.

1. Culverts shall be sized in accordance with the Energy Equation and applicable nomographs to carry the design flow and to provide a velocity between 2-10 feet per second during the 2-year storm event.
2. Open channels, ditches, and driveway pipes shall be designed based on the 10-year storm.
3. 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. Rip rap or synthetic matting shall be provided when velocities exceed 4 feet per second.
4. A Hydraulic Grade Line (HGL) study shall be performed for all public storm drainage systems. Where the public storm drainage system conveys storm water into a private SCM, the Q_{10} staging elevation shall be used as the starting point for the study. The study shall include profiles that show inverts, slopes, proposed finished grade and HGL. The HGL shall be required to stay within the pipe to ensure no surcharge on the system. ASTM Standard C443 (O Ring or Single Groove) water tight sealed pipe shall be used in cases where it is not practicable.
5. Stream crossings will necessitate a backwater study on the 100-year storm event. The localized

100-year flood elevation at each crossing is not allowed to stage onto an individual lot.

6. The minimum allowable slope is 0.50% or the slope which will produce a velocity of 2 fps when flowing full, whichever is greater for all proposed pipes and culverts.
7. Inlet spacing shall be sufficient to limit spread to no more 8ft during a 2-year storm.

Prediction of the peak flow rates resulting from a rainfall event shall be calculated using the procedure in the SCS TR-55, the Rational Method, or other calculation procedures acceptable to the Town of Lillington. Calculations shall include analyses of pre- and post-development run off rates from the project for the 1-year and 10-year storm event. All calculations shall be performed under the responsible charge of an appropriately licensed design professional and sealed by that professional. Storm drainage facilities shall be designed in a manner such that upstream and downstream properties are not adversely affected (Refer to the Article 6 of the Town of Lillington Unified Development Ordinance.

Discharge from the storm water drainage systems shall not be of such a velocity as to cause damage after leaving the pipe. Maximum allowable outlet velocity will be 2.5 feet per second (Refer to the Article 6 of the Town of Lillington Unified Development Ordinance). Exiting velocities shall be in conformance with the sedimentation and erosion guidelines and outlet protection used whenever the velocity exceeds the allowable limit. Pipe outlets, flared end sections and head walls shall be provided, with rip-rap aprons designed to reduce velocity and dissipate energy so that downstream damage from erosion does not occur. Calculations shall be submitted with plan review.

B. Location

Manholes or structures shall be installed at each deflection of line or grade. Acute angle junctions (angles less than 90 degrees) between pipe runs should be avoided. No inaccessible junction boxes shall be permitted. The maximum distance between access openings shall not exceed 400 feet.

Storm water shall not be allowed to flow across the roadway. Any deviation shall require pre-approval by the Town of Lillington. Catch basins shall be provided to intercept the flow prior to the radius of an intersection, or the design of the roadway shall indicate a continuous grade around the radius to allow the flow to continue down the intersecting street. The inlets shall be spaced using a maximum capacity of 5 CFS per single curb inlet. No catch basin shall be installed in the radius of a curve.

Storm water that is piped or is conveyed as open channel flow and originates within or passes through the public street rights-of-way shall be conveyed through a contiguous public drainage easement. The public drainage easement must extend from the public street rights-of-way through points downstream, to the point of open discharge.

In natural drainage ways, a storm drain main shall be extended to the property lines to readily enable future connection to adjoining upstream property. Storm design shall account for future upstream development based on the current land use plan and shall include an evaluation of the existing downstream storm capacity.

Private storm drainage systems will be permitted, provided that: (1) such systems collect and discharge impounded storm water wholly within the same lot; or (2) such systems collect water from one single lot and discharge into the public storm drainage system; or
(3) Such systems are properly engineered and approved on the signed set of construction drawings and recorded in a minimum 20ft easement. Private storm drainage systems that connect to the public storm drainage system shall have the connecting leg of such a system, which crosses into the public street

rights-of-way or easement, constructed in accordance with TOL specifications, including but not limited to: the necessary easements, piping, inlets and junction boxes. Connection of plastic pipe to TOL infrastructure is prohibited. Piped private storm drainage systems may not cross property lines, convey storm water from one lot to another unless criterion #3 is met, or point discharge adjacent to curb. Where permitted by topography and site conditions, storm drainage systems that serve a single non- residential lot (i.e., parking lots, private streets, vehicular use areas), shall be privately maintained.

C. Easements

All storm sewers shall be installed in dedicated street rights-of-way or easements. Minimum width of permanent storm drainage easements for public storm drain pipe shall be 20 feet. Where storm drain pipes are installed at a depth in excess of 10 feet or for pipes greater than or equal to 36-inch diameter, the easement widths shall be increased in accordance with the following table:

Pipe Diameter (in)	***Pipe Depth (D, ft.)***	***Easement Width (ft.)***
36 -- 48	$10 < D \leq 15$	30
54 -- 72	$15 < D \leq 20$	40
> 72	> 20	To be determined by the TOL

No structures or equipment such as buildings, fences, playsets, pools, HVAC units, etc. shall be placed within any public easement. The Town of Lillington is not liable for any damage to personal property located on public easements that may occur resulting from enactment of official duties.

Where multiple pipes are installed, the edges of the easement shall be a minimum of 10 feet from the centerline of the outside pipe with 3 feet clearance between the exterior of the parallel storm sewer pipes. Pipes shall not outfall in the front yard of a lot, but should extend to the rear third of the lot or property line in residential subdivisions.

D. Driveway Culvert

- The minimum pipe culvert shall be 15" inches or equivalent size as downstream pipe, whichever is greater to minimize clogging and maintenance. Material must be RCP or Double wall smooth inside, NCDOT approved
- Driveway culverts must have a minimum pipe cover equal to 12 inches measured from the proposed finish grade to the top of the pipe excluding any pavement or concrete.
- See "Table 1" at the end of these standards for further clarification.

E. Depth of Cover

Cover heights shall be as follows:

Reinforced Concrete Pipe (RCP)

- Cover heights exceeding chart below must be reviewed by the Town Engineering Department.
- The minimum cover for storm water pipe shall be 2 feet measured from the top of pipe to the finished subgrade under the roads and 1 foot to finished grade in non-load-bearing areas.

- Minimum pipe cover as listed below must be measured from the proposed finish grade to the top of the pipe excluding any pavement or concrete.

	RCP	
CLASS	***MIN (ft.)***	***MAX (ft.)***
III	2	15
IV	1	15

2 Materials – Storm Drainage Pipe

A. General

All materials and installation procedures, testing and acceptance of all publicly dedicated drainage infrastructures shall meet the requirements of the Town of Lillington Street and Storm Drainage Standards & Specifications Manual and lies in dedicated public right –of-way or dedicated 20' storm water easement. All storm sewer pipes to be installed in projects within the jurisdictional limits of the TOL shall conform to the specifications presented herein. In special cases where material other than those listed below is requested, the applicant's plan submittal must contain a formal request to use other material and complete background data to justify its use. The purpose of this policy is to establish a written standard on the type of pipe to be used in a ditch or tributary carrying storm water run-off from a dedicated public street or from property owned and maintained by the Town (herein "public water") which is either subject to review, maintenance or inspection by the Town or located within either the Town limits of Lillington, N.C. or under its extraterritorial jurisdiction.

B. Reinforced Concrete Pipe (RCP)

RCP shall be as per ASTM C76 (or the latest revision), Class III or Class IV with a minimum 15-inch diameter. All RCP installed on thoroughfare routes shall be approved and stamped by the NCDOT Materials and Tests Unit at the manufacturer's facility prior to delivery. Joints shall be sealed with a plastic cement putty meeting Federal Specification SS-S-00210 such as "Ram-Nek or a butyl rubber sealant." All concrete pipe to be used shall be either etched "RC X' (where X represents the class pipe) or marked visibly and legibly according to the following:

a) Stamp location: spigot end of pipe on inside.
b) Stamp size stenciled letters: 1-1/2" in height minimum.
c) Code Class 3 Reinforced Concrete: TWF-RC-3 d. Code Plain Concrete: TWF-P
d) Stamp color: fluorescent orange or red.
e) Unmarked pipe will be allowed only if the manufacturer furnishes a certified statement on the entire shipment and etchings are placed on each pipe joint.

Reinforced concrete pipe shall be inspected, evaluated, and reported on in accordance with ASTM C1840/C1840M : Standard Practice for Inspection and Acceptance of Installed Reinforced Concrete Culvert, Storm Drain, and Storm Sewer Pipe and AASHTO R 73 Standard Practice for Evaluation of Precast Concrete Drainage Products.
In addition to the specific inspection requirements above, any of the following criteria will be grounds for rejection of RCP material:

1) Any fracture or crack that visibly passes through the wall of pipe;
2) Any fracture or crack that is 0.01-inch-wide or greater at the surface and 12 inches or longer regardless of position in the wall of the pipe;

3) Offsets in form seam that would prevent adequate concrete cover over reinforcing steel;
4) Delamination in the body of the pipe when viewed from the ends;
5) Evidence of inadequate concrete cover for reinforcing steel;
6) Any severe surface condition that affects the majority of the pipe section surface and could reduce the durability and service life of the pipe;
7) Damaged or cracked ends where such damage would prevent making a satisfactory joint.
8) Joint offset/misalignment.

3 Materials - Storm Drainage Structures

A. General

All materials and installation procedures, testing and acceptance of all publicly dedicated drainage infrastructures shall meet the requirements of the Town of Lillington Street and Storm Drainage Standards & Specifications Manual and lies in dedicated public right –of-way or dedicated 20' storm water easement. All structures (manholes, curb inlets, catch basins, junction boxes, etc.) shall be constructed of concrete brick masonry units, cast-in-place reinforced concrete, or pre- cast concrete. Structures shall be repaired and re-built with solid concrete brick and mortar. Materials such as broken concrete pipe, clay brick, and rock are prohibited. Structure walls shall be repaired to original manufacturer conditions. Waffle boxes are not permitted unless written approval issued by the Town Engineering Department is issued. All pre-cast boxes shall be solid boxes. The purpose of this policy is to establish a written standard on the type of pipe to be used in a ditch or tributary carrying storm water run-off from a dedicated public street or from property owned and maintained by the Town (herein "public water") which is either subject to review, maintenance or inspection by the Town or located within either the Town limits of Lillington, N.C. or under its extraterritorial jurisdiction.

Curb inlets in streets with curb and gutter shall be NCDOT type standard frame, grate, and hood.

B. Concrete Brick Masonry Units

Concrete brick masonry units shall be solid units meeting the requirements of ASTM C55, Grade S-II. Clay brick shall be solid, rough, sound clay brick conforming to ASTM C32, Grade MS.

C. Precast Concrete Manholes

Pre-cast concrete manholes shall meet the requirements of ASTM C478. Manholes shall have joints sealed with a pre-formed rope-type gasket per ASTM C990. Manhole base diameters shall conform to the following for the various storm sewer pipe sizes:

Pipe Diameter (in)	*Manhole Base Diameter (ft.)*
15 - 36	5
42 - 48	6
54	8

For pipes greater than 54 inches, manhole base sections shall be sized as required and shall be approved

by the Engineer of Record and Town of Lillington. All precast manholes installed on thoroughfare routes shall be approved and stamped by the NCDOT Materials and Tests Unit at the manufacturer's facility prior to delivery.

Transition reducing slabs may be used to enable the use of 4-feet diameter eccentric cones at the top. All pre-cast manholes for storm sewers in traffic areas shall be of the eccentric type for ease of access. Manholes in non-traffic areas shall be flat-top type.

Other:

b. Other pipe material may be considered on a case-by-case basis due to adverse site conditions, depths or abnormal conditions with the approval of the Public Works Director.

c. Driveway culvert on Town right-of-way or easement. Please see pipe table within these standards.

D. Mortar

Mortar shall be proportioned as shown below for either Mix No. 1 or Mix No. 2. All proportions are by volume. Water shall be added only in the amount required to make a workable mixture.

MIX NO. 1: 1-part Portland Cement
¼ part Hydrated Lime
3¾ parts Mortar Sand (maximum)

MIX NO. 2: 1-part Portland Cement
1-part Masonry Cement
6 parts Mortar Sand (maximum)

E. Portland cement shall be ASTM C150, Type 1. Hydrated lime shall conform to ASTM C207, Type S. Masonry cement shall meet the requirements of ASTM C91. Mortar sand shall be standard size 4S, per requirements of the NC DOT.

F. Castings

1) General – All castings shall meet the requirements of ASTM A48, Grade 35B iron and shall be manufactured in the USA. Country of origin shall be embossed on each casting.

At a minimum, manufacturers shall submit the following to substantiate to the Engineer of Record and Town of Lillington that castings meet the minimum criteria:

a. Bar tensile test reports from an independent testing laboratory. The results must confirm that the material meets ASTM A48 Class 35B.
b. Casting proof load test report on the subject casting. Proof load tests shall be conducted in accordance with AASHTO M306, Section 7.0. During proof load testing, castings shall maintain a 40,000 lb. proof load for one minute without experiencing any cracking or detrimental deflection.
c. A written statement of certification by a qualified licensed engineer, employed by the producing foundry, that castings meet these specifications.

2) Curb Inlet - Curb inlets shall be of the grate, frame and hood type conforming to NCDOT 840.03, Type E, F and G, based on flow direction. Castings shall be Type V-4066 (2-5) as

manufactured by Vulcan Foundry Company, Southern Foundry SF-102 + SF-103 (C,E,F, or G) or US Foundry #5181. Grates with slots parallel to the curb are not permitted.

3) Grates & Frames - Cast iron grates and frames for yard inlets shall be of the size indicated on the approved plans. Grates and frames shall be in compliance with NCDOT Standards.

4) Manhole Rings & Cover - Cast iron manhole rings and covers shall conform to NCDOT 840.54, with the words "STORM SEWER" cast on the cover. Covers shall have four 1- inch holes. Manhole castings shall be machined to provide a continuous bearing around the full periphery of the frame. Covers shall be Vulcan V-1384, Southern Foundry SF-101 or US Foundry 669-KL.

G. Portland Cement Concrete

Portland cement concrete used for storm drainage structures, end walls, etc. shall conform to the technical requirements presented in Section 200 of these Specifications, and shall have a minimum compressive strength of 3,000 psi at 28 days. Primary structures, such as box culverts, may require concrete having a compressive strength greater than 3,000 psi, and may require the submission of mix designs and testing of the concrete by an independent laboratory. These special requirements may be imposed by the Engineer of Record and the Town of Lillington for all such structures where deemed necessary.

H. Reinforcing Steel

Reinforcing steel shall be new billet steel conforming to ASTM A615 for grade 60. Reinforcing steel shall be deformed per current ASTM standards.

I. Connections

All storm drain connections shall be made with non-shrink grout.

4 Miscellaneous Materials

A. Rip Rap

Riprap shall be large aggregate of the size and class shown on the approved drawings. Storm water calculations shall be submitted with the construction plan review application.

5 Inlets and Outlets

A. Headwalls, End walls, and Flared End Sections

Headwalls, end walls, and flared end sections shall be constructed of structural cast-in- place concrete or pre-cast concrete in accordance with NCDOT specifications and shall be installed at all discharge points and inlets where there is not a structure. Details and design of headwalls, end walls, and flared end sections shall be in accordance with NCDOT requirements. Details shall be shown on all plan submissions.

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

and on multiple pipe culverts less than 30 inches in diameter. Flared end sections shall also be installed at the outlet point of all storm drainage systems. Dissimilar pipe couplers shall be used to connect CPP, CSP, or CAP pipe to end sections.

Headwall and end wall shall be installed on single pipe culverts greater than 36 inches in diameter, and on multiple pipe culverts greater than and including 30 inches in diameter.

B. Dissipaters and Scour Protection

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

Scour protection shall be provided for all drainage ways where, in the opinion of the Engineer of Record or the Town of Lillington, erosive velocities or other factors require the use of protective measures. All protective measures shall be shown on all plan submissions.

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

6 Construction Methods

A. Trenching & Bedding for Storm Sewers

The trench shall be excavated to the line and grade indicated on the Drawings. The trench bottom shall provide a firm and uniform support for the pipe. Where bell and spigot type pipe is used, recesses shall be excavated to receive the pipe bell. Where the foundation is found to be of poor supporting value, the pipe foundation shall be conditioned by undercutting the unacceptable material to the required depth as directed by the Engineer of Record and backfilling with stone or other approved material. Where necessary, surface water shall be temporarily diverted in order to maintain the pipe foundation in a dry condition. The flow of water from such temporary diversions shall be directed into suitable erosion control devices.

B. Pipe Laying

Concrete pipe culverts shall be laid carefully with bells or grooves upgrade and ends fully and closely jointed. Preparation of bedding and backfill shall be as specified on the Drawings and per the requirements of the American Concrete Pipe Association's Design Data 9 or ASTM C1479. Pipe shall be laid with uniform bearing under the barrel of the pipe. For projecting bell pipe, bell holes shall be provided. Pipe shall not be laterally displaced by pipe embedment material installed as provided in the drawings. No pipe shall be laid in unsuitable bedding conditions such as, but not limited to, water in the trench or hard rock. Pipe shall be laid with bell ends facing the direction of laying except when making closures. When the design requires special bedding conditions for culverts or storm drains, an excavation diagram will be shown on the plans. Do not exceed these limits of excavation. The length of trench excavation in advance of pipe laying shall be kept to a minimum. All material excavated from trenches and piled adjacent to the trench shall be maintained so that the toe of the slope is at least 2 feet from the edge of the trench. It shall be piled to cause a minimum of inconvenience to public travel, and provision shall be made for merging traffic where necessary. Free access shall be provided to all fire hydrants, water valves, and meters; and clearance shall be left to enable free flow of storm water in gutters, conduits, or natural watercourses. Joints and gaskets shall be installed in strict conformance with the pipe manufacturer's recommendations. Pipe shall be laid to line and grade as

shown on the plans.

C. Backfilling

The storm sewer trench shall be backfilled with approved material free from large stones or clods in 6-inch layers, loose measurement, and compacted to 95% of maximum dry density (AASHTO T-99), where the trench is within an area to be paved, or where the trench is immediately behind the curb. In streets the compaction requirement shall be increased to 100% of maximum dry density within 12" of subgrade. The backfilling shall be done on both sides of the pipe simultaneously to prevent displacement of the pipe. The backfill materials shall be moistened when necessary in the opinion of the Engineer to obtain maximum compaction. Water settling or puddling shall not be permitted. Backfill in trenches not within the limits to be paved may be compacted in 12-inch layers after backfill is one foot above the top of the pipe. All trash, forms, debris, etc., shall be cleared from around all pipes and structures before backfilling. Backfilling around structures shall be done symmetrically and thoroughly compacted in 6-inch layers with mechanical tampers to the specified 95% density. All trash, forms, debris, etc., shall be cleared from the backfill material before backfilling. Backfilling around structures shall be done symmetrically and thoroughly compacted in 6-inch layers with mechanical tampers to the specified 95% density (Standard Proctor).

D. Masonry Structures

Excavations shall be made to the required depth, and the foundation, on which the brick masonry is to be laid, shall be approved by the TOL. The brick shall be laid so that they will be thoroughly bonded into the mortar by means of the "shove-joint" method. Buttered or plastered joints will not be permitted. The headers and stretchers shall be so arranged as to thoroughly bond the mass. Brickwork shall be of alternate headers and stretchers with consecutive courses breaking joint. All mortar joints shall be at least 3/8 inches in thickness. The joints shall be completely filled with mortar. No spalls or bats shall be used except for shaping around irregular openings or when unavoidable to finish out a course. All details of construction shall be in accordance with approved practice and to the satisfaction of the Engineer of Record and Town of Lillington.

Steps as shown on the plans shall be placed in all catch basins and inlets when they are greater than five feet in depth. The steps shall be set in the masonry as the work is built up, thoroughly bonded, and accurately spaced and aligned.

Inverts in the structures shall be shaped to form a smooth and regular surface free from sharp or jagged edges. They shall be sloped adequately to prevent sedimentation. The castings shall be set in full mortar beds. All castings when set shall conform to the finish grade shown on the drawings. Any castings not conforming shall be adjusted to the correct grade.

E. Concrete Construction

The forming, placing, finishing, and curing of Portland cement concrete shall be performed in strict accordance with all applicable requirements as contained in the Standard Specifications for Road & Structures latest edition, as published by the NCDOT and pertinent ACI (American Concrete Institute) codes and guidelines.

F. Installation of Precast Concrete Structures

Pre-cast concrete manholes, junction boxes, etc. shall be installed level and upon a firm, dry foundation, approved by the Engineer of Record and Inspector. Structures shall be backfilled with suitable materials, symmetrically placed and thoroughly compacted so as to prevent displacement. Castings shall be set in full mortar beds to the required finished grade. Refer to the Standard Detail.

7 Inspections Prior to Acceptance

The Utility Contractor must coordinate with The Engineer of Record and the Town of Lillington for regular inspection visitations and acceptance of the storm system.

The Engineer of Record is responsible to ensure that construction is, at all times, in compliance with accepted sanitary engineering practices and approved plans and specifications. No field changes to the approved plans are allowed without prior written approval by the TOL and the EOR. A copy of each engineer's field report is to be submitted to the Town as each such inspection is made on system improvements or testing is performed by the contractor including geotechnical reports used to meet said specifications noted above. Storm infrastructure must pass all inspections and tests required by the design and construction documents and TOL standards and specifications.

The following items must be inspected prior, during and after installation of storm drainage lines and appurtenances:

- All products are subject to final visual inspection for shipping and handling damage, fit and other visual defects and disposition to the project site in accordance with AASHTO R73.
- Verify concrete pipe acceptance report is current and covers manufacturing plant, pipe diameter, class of pipe, ASTM Standard the pipe was manufactured to, date the pipe was manufactured
- All boxes and manholes for presence of weep holes, formed inverts, bolted down castings, pipe flushed against inside wall of box, steps and location of steps, proper corbeling of brick/block in accordance with the details and specs, wall thickness and depth of manhole.
- Pipe for cracks, pipe markings for compliance with specifications (painted and etched).
- Removal of debris and sediment in both pipe and box.
- Rip rap outlet protection and filter fabric, stilling basin compliance with plan.
- Manhole casting cover reading "storm drainage."
- Armor protection of ditches (concrete and/or temporary liners), scour and erosion.
- Contractor to provide video documentation of entire storm drainage system. A copy of this video inspection will be provided to the Public Works Department during the acceptance and dedication process. Staff must be present during the videotaping process.
- All inspections must be scheduled 48 hours in advance. Inspections will be performed in the order received. Every effort will be made to accommodate the time of request; however, this cannot be guaranteed.

Upon completion of construction the developer/contractor shall request a warranty inspection. Upon completion of all punch list items, the provision of a set of acceptable record drawings, and the submission of engineer's certifications, a one-year warranty period shall commence.

The Engineer of Record shall submit a certification to the Town of Lillington outlining that the installation of the storm system has been completed in accordance with accepted engineering practices and approved plans and specifications.

Prior to acceptance of any development with public storm drainage infrastructure, the utility contractor

shall arrange a camera inspection of all public storm drainage lines with a 3rd party camera service and then coordinate the results with the Engineer of Record and Town of Lillington Engineering Department. Any discrepancies found in violation of these Specifications shall be repaired to the satisfaction of the Engineer of Record and Inspector. Prior to acceptance and prior to issuance of any Certificates of Occupancy. When inspection indicates possible excessive deflection in storm piping the contractor shall complete a deflection test by mandrel using a rigid device approved by the Engineer of Record and Inspector. The mandrel size shall be clearly labeled and shall be sized so as to provide a diameter of at least 95% of the inside pipe diameter. If deflection exceeds 5%, the pipe shall be evaluated to determine what corrective measures are required.

Video Assessment and Cleaning

a) As a final measure required for acceptance the Contractor shall clean and televise all newly installed public storm drain lines installed from the upstream to downstream manhole with no reverse setups or cutaways. Throughout shooting, the camera shall be panned and tilted for a complete view of the line. Lighting shall be adequate to view the entire storm drain line from beginning to end. The video inspection shall be submitted to the TOL on a CD/DVD and formatted with software compatible and readable by the TOL. The TOL shall not be responsible for purchasing additional software necessary to view the CD/DVD.

b) The camera shall be advanced at a uniform rate not to exceed 20 feet per minute that allows a full and thorough inspection of the new storm drain line. The camera shall be a color, pan and tilt camera capable of producing a five-hundred-line resolution picture. Lighting for the camera shall be sufficient to yield a clear picture of the entire periphery of the pipe. The picture quality shall be acceptable and sufficient to allow a complete inspection with no lapses in coverage. The length of the storm drain line shall be measured and recorded on the video screen. The distance counter shall be calibrated before shooting the inspection video.

c) The Contractor shall clean the storm drain lines ahead of video inspection with a high-velocity water jet. The video inspection shall take place within 2-hours of cleaning operations as witnessed by the TOL. All construction debris shall be collected in the downstream manhole and shall not be released into the storm drain system.

d) The TOL shall be present throughout the cleaning and televising of the storm drain lines to verify that the video work complies with the Specifications. The camera operator shall stop, reverse, pan, and tilt the camera to view any area of interest during the inspection as directed from the TOL.

e) It is recommended that site grading and all utilities be installed and complete prior to final inspection to ensure that damages to the storm drain lines do not occur. Damages found after final inspection would requiring re-inspection by the TOL.

f) Prior to submitting the CD/DVD to the TOL, the Contractor shall label the CD/DVD with the following information:

- Name of the Project/Development.
- Name and contact information of responsible party.
- Date of televising.
- Manhole identification as shown on the design plans.

g) Inspections must follow:
- ASTM C1840/C1840M : Standard Practice for Inspection and Acceptance of Installed Reinforced Concrete Culvert, Storm Drain, and Storm Sewer Pipe
- AASHTO R 73 Standard Practice for Evaluation of Precast Concrete Drainage Products
- NCDOT Guidelines and Specifications and meet material specifications as listed in Section 2 b.

8 Maintenance of Municipal Separate Storm Sewer System

The TOL shall maintain all piping and structures within TOL identified easements. The easements must be labeled as the following: "Town of Lillington Public Utility Easement" or "Town of Lillington Drainage Easement". Easements labeled as "Drainage Easement" or "Private" shall be maintained by the responsible party or property owner where such system is located.

TOL maintenance will stop just beyond one half the distance of the total recorded easement width which is measured from the end of the pipe or the center of a flared end section. TOL maintenance responsibilities are summarized in the following table.

Easement Width (ft.)	***Maintenance Distance (ft.)***
20	10
30	15
40	20

When an approved private drainage system is designed and installed onto private property and connects to the TOL street rights-of-way, a TOL approved storm water structure will be required and placed no further than 10 feet from the recorded or proposed street rights-of-way. A TOL approved easement will be placed around the storm water structure that meets the current TOL specifications. The TOL shall stop all maintenance activities at this point. A private easement boundary shall be shown beyond this point and recorded to describe and allow ownership inspection and maintenance activities. The TOL shall not be responsible for any infrastructure, grassed swales, or other storm water conveyances located within private easements.

Warranty

Warranty and Defects Guarantee: Upon the acceptance of facilities, utilities or streets for permanent maintenance, a one-year warranty for all improvements shall become effective. This warranty must be satisfactory to the Town of Lillington. In addition, the Developer shall provide surety in the amount of 15% of the total construction cost to guarantee the correction of all defects in such facilities, utilities or streets that occur within the warranty period described above.

For the purposes of this section, the term "defects" refers to any condition in publicly dedicated facilities, utilities or streets that requires the Town to make repairs to such improvements over and above the normal amount of maintenance that they would require. If such defects appear, the warranty may be enforced regardless of whether the facilities, utilities or streets were constructed in accordance with the requirements of this ordinance.

During the one-year warranty period the developer shall repair any latent defects which occur. At the end of the one-year warranty period the developer shall request a final inspection. Upon successful completion of all warranty items the developer shall be released from maintenance responsibilities for the warranted construction.

If a developer fails to complete warranty items, future projects of the developer shall not be reviewed by the Department of Public Works. In addition, the Town may take additional legal action against the developer.

Warranty repairs to the following common problems shall be as follows:

a. Street pavement trench failures shall be repaired in accordance with specification details

b. If more than 3 trench failures occur within a longitudinal distance of 800 feet on any segment of a street, the Town shall require a 1-inch overlay once repairs have been completed. Town of Lillington Roadway Sidewalk & Drainage Pipe Specifications

c. Cracks in sidewalk and/or curb and gutter shall be repaired by removing and re- pouring such sections as necessary;

d. All storm sewer systems, ditches and gutters shall be free of debris, dirt or silt;

e. All drainage and street appurtenances shall be in perfect condition and properly exposed.

f. All other defects shall be corrected in accordance with the recommendations of the Town of Lillington Public Works Director

TABLE 1.

Drainage Location	Type of Pipe	Installation Requirements	Maintenance Responsibility	Material and Installation Cost & Responsibility
Driveway Culvert on Town ROW or Town Easement	15" or equivalent size as downstream pipe, whichever is greater. Material must be RCP or Double wall smooth inside.	Per TOL and NCDOT spec.	Town will maintain clear flow-owner replaces damaged pipe as needed	Property Owner
Roadside Ditch in Town ROW or Town Easement	N/A	Per Spec and Details. Positive flow without creating adverse conditions	Town will maintain clear flow – Town will remove sediment and install matting as needed	Town of Lillington
Cross Street Culverts and Storm Drain structures in Town ROW or Town easement	RCP, Reinforced Concrete Box Culvert	Per Spec and Details.	Town of Lillington	Town of Lillington
Storm drainage improvements– no easement or private easement/property	Varies	Per Engineered Plans and Specifications. Installed by a licensed utility contractor.	Property Owner(s)	Property Owner(s)
Ditch, Drainage Swell and Storm Drain Structures in NCDOT ROW or NCDOT Easement	RCP or as approved by NCDOT	Per NCDOT Specifications	Per NCDOT Policy	Per NCDOT Policy

Subdivision or street improvements to include storm water Completed by Developer/Property Owner	RCP 15” or greater	Per Town of Lillington Approved Plans and Specifications Installed by a licensed utility contractor	Property Owner or Developer will dedicate project at completion and maintenance will provide by the Town of Lillington	Property Owner or Developer – After dedication – Town of Lillington responsible maintenance and repair

Standard Street Sign Specifications

The following is the standard for the installation of Stop Signs and Street Name Signs within the Town of Lillington. Developers and/or Contractors shall adhere to the standards set forth herein for all roadways, except for NCDOT roadways, constructed within the jurisdiction of the Town of Lillington.

The Developer and/or Contractor shall adhere to all conditions set forth including the widths, length, configuration, other features and appurtenances defined on the approved preliminary plan and construction drawings. No deviation from the approved plans and the standards indicated herein shall be allowed without the expressed written permission of the Town of Lillington or their authorized representative.

Stop Signs

a. Stop signs shall be installed on a 3 lb/ft U-Channel Post.
b. Stop signs shall be 30 inches by 30 inches.
c. Stop signs shall follow MUTCD standards.

Street Name Signs

a. Street Name Signs shall be installed on a round post.
b. Street Name Signs shall be dual sided blades.
c. Street Name Sign names shall follow the MUTCD standards.
d. 25 mph Speed Limit Zones shall have 6-inch tall Street Name Signs.

35 mph Speed Limit Zones shall have 9-inch tall Street Name Signs.

e. All Street Name Signs shall have a .5-inch white border.