# CITY OF CHARLOTTESVILLE  
CITY STANDARDS AND DESIGN MANUAL  

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CHAPTER 1 – INTRODUCTION

100 Intent and Purpose

The City of Charlottesville recognizes the need for a unified City-wide Design Manual that identifies minimum Standards and Design Criteria to be used for development and redevelopment within the City limits. The purpose of this manual is to present the minimum standards and design criteria and identify references for use in the planning, design and construction of new development and redevelopment in the City of Charlottesville.

101 Materials and Methods of Construction for Improvements

Materials and methods of construction of all improvements required in subdivisions, site development, redevelopment, public and private streets, utilities, and any improvements within the public right-of-way shall be in accordance with standards and specifications prescribed by this City of Charlottesville Standards and Design Manual, hereinafter referred to as the Manual.

102 References

Code of Ordinances, City of Charlottesville consisting of Chapters 1 through 34 each inclusive.

Virginia Department of Transportation Road and Bridge Standards, current edition.

Virginia Department of Transportation Road and Bridge Specifications, current edition.

Virginia Department of Transportation Road Design Manual, current edition.


Virginia Department of Transportation, Location and Design Instructional Memoranda (IIM-LD-55).

Virginia Department of Transportation Bicycle Facility Guidelines, current edition.


ITE Standards for Vehicle Traffic Control Signal Heads

ITE Standards for pedestrian Traffic Control Signal Indications

ITE Standards for Lane-Use Traffic Control Signal Heads


FCC Telecommunications Manual


Trip Generation, Institute of Transportation Engineers, current edition.


Virginia Supplement to the Manual on Uniform Traffic Control Devices.


Virginia Department of Transportation Roundabout Brochure.

Virginia Stormwater Management Regulations as set forth within 4 VAC 3-20 et. Seq.


Virginia Administrative Code Chapter 590 Waterworks Regulations 12 VAC-590 inclusive, Virginia Department of Health.

Virginia Administrative Code Chapter 581 Sewage Collection and Treatment Regulations 12 VAC 5-581 inclusive, Virginia Department of Health.

AWWA Standards, American Water Works Association.


The Construction Specifications Institute (CSI) Plan Review.
Engineering Checklist – webpage link: http://www.charlottesville.org Neighborhood Development Services/Engineering

Stream Buffer Requirements – City Code, Chapter 10, Article IV and webpage link: Parts 1, 2, and 3: http://www.charlottesville.org Business/Laws and Codes


Traffic Calming Guidelines: http://www.charlottesville.org Neighborhood Development Services/Transportation
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<td>American Institute of Architects</td>
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<td>AASHTO</td>
<td>American Association of State Highway and Transportation Officials</td>
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<td>AAN</td>
<td>American Association of Nurserymen</td>
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<tr>
<td>ACI</td>
<td>American Concrete Institute</td>
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<td>ACSA</td>
<td>Albemarle County Service Authority</td>
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<td>Americans with Disabilities Act</td>
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<td>Automatic Meter Reading</td>
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<td>American National Standards Institute</td>
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<td>ksi</td>
<td>Thousand pounds per square inch</td>
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<tr>
<td>VESC</td>
<td>Virginia Erosion and Sediment Control</td>
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<td>VDH</td>
<td>Virginia Department of Health</td>
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<td>VDOT</td>
<td>Virginia Department of Transportation</td>
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<td>VDPOR</td>
<td>Virginia Department of Professional and Occupational Regulation</td>
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<td>VMRC</td>
<td>Virginia Marine Resources Center</td>
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<td>VTM</td>
<td>Virginia Test Methods</td>
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<tr>
<td>VUSBC</td>
<td>Virginia Uniform Statewide Building Code</td>
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<tr>
<td>WWF</td>
<td>Welded wire fabric</td>
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104 Definitions

Agent means (i) the Director of Neighborhood Development Services, or his designee or (ii) the Planning Commission, in cases where the Planning Commission is the designated approving authority; provided, however, that only the following persons shall have the authority to sign any final plat on behalf of the city: (i) the Director of Neighborhood Development Services, or (ii) in cases where the Planning Commission is the designated approving authority, the chairman of the planning commission.

Agreement - the written contract between Owner and Contractor covering the Work to be performed; other contract Documents are attached to the Agreement and made a part thereof as provided therein.

Alley - a form of vehicular travelway providing access to the rear or side lot line of abutting properties that front along streets. An alley is privately owned and maintained, is intended to be used primarily by the owners and occupants of the abutting properties and vehicles providing services to those properties (including emergency vehicles) and is not intended for through traffic. An alley is not a “private street.”

Applicant - the owner of land proposed to be subdivided or involved in any site construction, or the owner’s representative. Consent shall be required from all legal owners.

As-built - Construction plans and details that have been edited after construction to reflect accurate locations and features of all appurtenant utilities.

Bedding - a layer of granular material, gravel, or crushed rock immediately below and supporting a conduit or fully or partially encasing a conduit. Material existing in a trench, ditch, or tunnel, upon which conduit is placed directly, is considered to be bedding.

Bid - the offer or proposal of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

Building Sewer - In plumbing, the extensions from the building drain to the public sewer or other place of disposal. Also called a building connection.

Block - a tract of land bounded by streets or by a combination of streets and railroad rights-of-way, the corporate limits of the city or shorelines of watercourses.

Blotted Seal Pavement - a penetration surface course pavement having more than one application of asphalt and aggregate. A fine aggregate is placed on top of the initial seal to blot or choke the coarse aggregate.
**Bond** - any form of security including a cash escrow, surety bond, certified check or letter of credit in an amount and form satisfactory to the city attorney. All bonds shall be approved by the city attorney wherever a bond is required by this chapter.

**Boundary line adjustment** - a type of subdivision in which one or more lot lines are relocated or altered so that the land exchanged is added to and becomes part of an existing lot.

**Building** - a structure enclosed within exterior walls and a roof, built, erected and framed of component structural parts, designed for the housing, shelter, enclosure and support of individuals, animals or property of any kind.

**Building Sewer** - in plumbing, the extensions from the building drain to the public sewer or other place of disposal. Also called a building connection.

**Change Order** - a written order issued by the City to the Contractor directing certain changes, additions, or reductions in the Work or in the materials used.

**City** - the City of Charlottesville, Virginia, referred to as Owner.

**City Engineer** - that employee who oversees the land development functions for Neighborhood Development Services (NDS) as assigned by the current City Engineer. In the context of this document, the term can also refer to City Engineer or assigned designee responsible for the review and approval.

**Commission** - the Planning Commission for the City of Charlottesville.

**Common area** - an area shown on a plat that is not a platted lot for sale but is either owned or will be owned in common by the lot owners within the subdivision or, if not owned in common, is available for the common use of the lot owners within the subdivision.

**Construction approval** - A letter issued by the City of Charlottesville to a developer that authorizes him to construct facilities for which the design plans and specifications have been approved by the City of Charlottesville.

**Contract Documents** - the Contract, Contract Bond, General Conditions, Special Conditions, Specifications, and Plans, together with all Addenda, Change Orders, and Supplemental Agreements covering the project.

**Contractor** - the person, firm, or corporation with whom Owner has entered into the Agreement.
**Dark Sky** - refers to the City’s dark sky ordinance which denotes lighting regulations that minimize the amount of light that shines into the sky hindering the natural views. *As it applies to lights, a light fixture that does not cast any light above a ninety (90) degree plane from a downward angle is considered to be dark sky compliant.*

**Dedicated right-of-way** - shall refer to the area that must be dedicated to the city in fee simple for public use for and in connection with a public street, including, without limitation, the paved street surface, adjacent curb, gutter and drainage improvements, water and sewer mains, required sidewalks and utility easements.

**Department of Public Works** - the Department of Public Works of the City of Charlottesville, Virginia, its designated employ in charge of the project, or contracted representative.

**Developer** - any person, firm, corporation or association having an interest in construction improvements to alter the use of land. Of particular interest to the City are developers constructing facilities to be dedicated to public use within the jurisdictional area of the City.

**Development** - a tract of land developed or to be developed as a unit under single ownership or unified control which is to be used for any business or industrial purpose or is to contain three or more residential dwelling units. The term “development” shall not be construed to include any property which will be principally devoted to agricultural production.

**Drainage Control** - the removal, collection or conveyance of runoff from or on property through structural facilities or other measures.

**Drainage Ditch** - a natural or artificially constructed open depression for the purpose of carrying off surface water.

**Drawings** - the drawings which show the character and scope of the Work to be performed by the Contractor and which have been prepared or approved by the City and are referred to in the Contract Documents.

**Driveway** - a form of vehicular access from a street or alley to the interior of a lot.

**Easement** - a reservation or a grant by a property owner of the use of land for a specific purpose or purposes, other than a license revocable by the unilateral act of the grantor.

**Engineer** - an individual, firm, association, properly qualified person, or the legally authorized representative(s), designated by the Owner, experienced in and legally qualified to practice the profession involved. The term shall apply to the Owner when the Owner is acting as its own Engineer.
**Frontage** - the continuous uninterrupted distance along which a parcel abuts an adjacent street.

**Grade** - the slope of a road, street or other public way, expressed as a percentage.

**Guarantee Period** - one year following the date of final acceptance of the work by the Owner unless otherwise specified.

**Improvement** - all public utilities and facilities required by this chapter, including, without limitation: streets, turnarounds, traffic signalization and controls, sanitary sewers, stormwater management and corrosion control facilities, drainage control facilities, curbs, curb and gutters, and sidewalks, regardless of whether such utilities and facilities are publicly or privately owned and/or maintained.

**Infiltration** - (for sanitary sewers) groundwater entering sewers through defective joints and cracks in pipes and manholes.

**Infiltration Practices** - (for stormwater management) Structures used to infiltrate runoff and to facilitate percolation through the subsoil. The purpose of these structures is to infiltrate stormwater runoff from impervious surfaces with no direct discharge to surface waters.

**Inflow** - water discharged into sewers from foundation and roof drains, outdoor paved areas, cooling water from air conditioners, and unpolluted discharges from businesses and industries.

**Inspector** - the person appointed by the City, whose duty it is to inspect the materials used, and sees that the work is performed in accordance with the Contract documents; and carries out such instructions as given him by the Engineer.

**Interceptor** - a sewer that receives sewage flow from a number of gravity mains, trunk sewers, sewage force mains, etc. On June 23, 2006, the City of Charlottesville officially defined interceptors as continuous sections of 24” diameter and greater sanitary sewer lines that continue to increase in diameter as they approach the RWISA interceptor.

**Invert** - the lowest point in the internal cross-section of a pipe.

**Lateral** - a sewer that has no other common sewers discharging into it. These lines are generally 4” diameter.

**Laws and (or) Regulations** - any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
Lot - a lawfully created unit, division or piece of land shown on a plat of record, or described by metes and bounds or other legal description, and is synonymous with the terms “tract,” “parcel,” and “plot.”

Lot, corner - a lot abutting upon two (2) or more street rights-of-way at their intersection.

Lot, depth of: the term “depth of lot” - the mean horizontal distance between the front and rear lot line.

Lot, double frontage - an interior lot having frontage on two (2) streets with non-intersecting rights-of-way, as distinguished from a corner lot.

Lot, width: the term “width of lot” - the mean horizontal distance between the side lot lines.

Main or trunk - a sewer that receives sewage flow from one or more sub main sewers. Sewer mains are generally 8” or 10” diameter. Sewer trunks are hereby defined as 12”, 15”, 16”, 18”, and 21” diameter.

Natural stream - a nontidal waterway or channel that is part of the natural topography, which typically will maintain a continuous, seasonal or intermittent flow during the year, and which is characterized as being irregular in cross-section with a meandering course. A constructed channel, such as a drainage ditch or swale, is not a natural stream.

Open space - an area containing water or land, or a combination thereof, that is unoccupied by building lots or streets, and which may be vegetated, developed with amenities or utilities, or left in an undisturbed state.

Paved Surface - area of street with final top coat of asphalt. City Street Standards require an 8” base layer of aggregate topped with a 2” layer of asphalt. The term “paved surface” does not include the curbs, curb and gutter, or sidewalks.

Person - a natural person, corporation, partnership, sole proprietorship, trust, trustee, joint venture, and any other legal entity.

Phased subdivision - a subdivision for which a preliminary plat is approved for the entire property, and for which two or more final plats, individually pertaining to less than the entire property, is submitted sequentially for review and approval.

Planning Commission - The Charlottesville City Planning Commission meets on the Second Tuesday of each month at 6:30 p.m. in the City Council Chambers. At that meeting, the Commission considers rezoning applications, special permit applications, site plans, subdivisions and other matters pertaining to the
development of the community. The Planning Commission also conducts a regular review and update of the adopted Comprehensive Plan and from time to time, performs special studies of planning.

*Plans* - the drawings which show the character and scope of the Work to be performed by the Contractor and which have been prepared or approved by the City and are referred to in the Contract Documents.

*Plat* - and refers to the schematic representation of land divided or to be divided.

*Plat, final* - a plat upon which the plan for a subdivision is presented for approval pursuant to this chapter, whether or not preceded by an approved preliminary plat, which is in final form suitable for recording in the land records of the City of Charlottesville, as contemplated by Va. Code §15.2-2254 of the Virginia Code and the City’s subdivision ordinance, and which has been signed by the city’s agent.

*Plat, preliminary* - a plat upon which the plan for a subdivision is presented for preliminary approval pursuant to this chapter, and which is not in final form for recording in the City’s land records.

*Potable Water* - water suitable for human consumption and domestic use.

*Resubdivision* - the division of land by subdivision, where the land being subdivided is the subject of a previously-approved and recorded subdivision plat.

*Right-of-Way (ROW)* - *The* term “dedicated right-of-way” refers to that area which must be dedicated in fee simple for public use. Within such dedicated right-of-way shall be located the paved street surface and adjacent curbs and, where required, sidewalks.

*Roadway* - that portion of the street intended for use of vehicular traffic.

*Ruled Joints* - joints placed at measured intervals.

*Sanitary Sewer* - a pipe or conduit that carries wastewater.

*Sewer Service* - See “Lateral”.

*Setback* - the required distance between a structure and the property line.

*Shared driveway* - a vehicular access to only two lots which have frontage on a street and which are authorized by this chapter and by the City’s zoning ordinance.
Shop Drawings - all drawings, diagrams, illustrations, brochures, schedules, and other data that are prepared by the Contractor, a Subcontractor, manufacturer, supplier, or distributor that illustrate the equipment, material, or some portion of the Work.

Sidewalk - a paved pedestrian way designed to meet City standards.

Site review committee - a committee established by the director of neighborhood development services, consisting of City employees, composed of representatives of the Department of Neighborhood Development Services; the City’s fire code official or his designee; the City’s building official or his designee; the Board of Architectural Review (BAR); the Department of Public Works, its service and utilities division; and other employees or officials whose input may, in the opinion of the director, be of assistance in reviewing a proposed subdivision plat.

Specifications - those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards, and workmanship as applied to the Work and certain administrative details applicable thereto.

Staff - employees of the City.

Standard crown - the cross slope of the roadway pavement and should be 1/4 inch per foot (2%), unless otherwise increased by the Engineer.

Storm Sewer - a sewer that carries storm water and surface water, street wash and other wash waters, or drainage, but excludes domestic wastewater and industrial wastes. Also called a storm drain.

Street - the whole right-of-way included between property lines, reserved for the accommodation of the traveling public, and its appertaining structures and slopes, and all ditches, channels, waterways, etc., necessary to its correct drainage.

Street, Principal Arterial - a street that serves the major centers of activity, the highest traffic volume corridors, and the longest trip desires. The principal arterial carries most of the trips entering and leaving the City. In addition, significant intra-city travel, such as between business districts and outlying residential areas, between major inner-city communities, and between major suburban centers is served by this class of facility. Principal arterials are designated as such on the road classification plan adopted by City Council.

Street, Minor Arterial - interconnects with and augments the principal arterial. The minor arterial street places more emphasis on land access than the principal arterial and provides lower traffic mobility. It may carry local bus routes and
provides intra-community continuity but ideally does not penetrate identifiable neighborhoods. Minor arterials are designated as such on the road classification plan adopted by City Council.

*Street, Collector* - provides both land access service and traffic circulation within residential neighborhoods and commercial and industrial areas. It differs from an arterial in that it may penetrate residential neighborhoods. The collector street also collects traffic from local streets in residential neighborhoods and channels it into the arterial system, and it may carry local bus routes. A collector street is designated as such on the road classification map adopted by City Council.

*Street, cul-de-sac* - a local street with only one (1) outlet and an appropriate terminal for the safe and convenient reversal of traffic movement.

*Street, local* - a road designed to provide direct access to adjacent land and serve travel of short distances as compared to the higher functional classifications.

*Street private* - any street or other way or means of vehicular access that is not designed, constructed, bonded or approved to be maintained by the City as part of its urban highway system regardless of ownership.

*Street, public* - an area that is encompassed by a right-of-way dedicated to public use for vehicular travel and accepted for maintenance by the City as part of the City’s public street system. Any requirement of this chapter that refers to an existing public street shall mean a public street currently maintained by the City of Charlottesville.

*Street right-of-way* - the total width of the strip of land dedicated or reserved for travel, including pavement, and which also includes, but is not limited to related improvements, such as: curbs, curbs and gutters, shoulders, ditches, public sidewalks, bicycle paths, and, where necessary, public utility casements.

*Subcontractor* - an individual, firm, or corporation having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the site.

*Subdivide* - the process of dividing land to establish a subdivision.

*Subdivider* - one or more persons who own property to be subdivided, and such person(s)’ successors in interest.

*Subdivision* - (i) the division of a parcel of land into three or more lots or parcels for the purpose of transfer of ownership or building development, including, without limitation, establishment of a condominium regime; (ii) any division of a parcel of land, if a new street is involved in such division; and (iii) a family
division. The term includes re-subdivision and, when appropriate to the context, shall relate to the process of subdividing or to the land subdivided.

Subdivision, major - any subdivision which involves more than ten (10) lots or the creation of new streets, extension of public utilities or facilities.

Subdivision, minor - any subdivision containing ten (10) or fewer lots, all of which front on an existing dedicated and accepted city street and which does not require the extension of public utilities.

Submain - a sewer that receives flow from one or more lateral sewers. These sewers are generally 6” and 8” diameter.

Superintendent - the executive representative of the Contractor authorized to receive and fulfill instructions from the City and supervise and direct the construction.

Terminus - the end of a street within the City or the boundary of the City limits.

Wastewater - the spent water of a community. From the standpoint of source, it may be a combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water, and storm water that may be present.

Water protection ordinance - the provisions set forth within Chapter 10 of the Code of the City of Charlottesville (1990), as amended.

Water Service - water supply pipeline to a customer’s building service line.

Work - the entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Contract Documents.

Zoning ordinance - the provisions set forth within Chapter 34 of the Code of the City of Charlottesville (1990), as amended.
CHAPTER 2 – NEW PUBLIC STREET AND PRIVATE ALLEY CONSTRUCTION

200 Intent and Purpose

It is the intent of the City of Charlottesville to encourage new development to provide streets that meet or exceed the minimum standards and design criteria to provide safe and efficient access and mobility for vehicles and pedestrians. This Chapter presents descriptions of the planning and design process for new transportation facilities. It provides guidance and references for the developer to use in preparing designs for new streets and private alleys. Chapter 2 also provides guidance for making the required submittals of roadway plans to the City of Charlottesville for review and approval prior to construction.

201 General

Geometric design criteria for all roadways shall be in accordance with this City Standards and Design Manual, (Manual); the current Virginia Department of Transportation Road and Bridge Specifications; Virginia Department of Transportation Road and Bridge Standards; the Virginia Department of Transportation Road Design Manual, and the AASHTO Roadside Design Guide. If one of these references differs from the Manual on the same requirement, the City Standards and Design Manual shall prevail.

In the event of conflict among the VDOT Road Design Manual, Road and Bridge Standards, and/or other references, the Engineer shall determine the governing provision. The Engineer is provided considerable discretionary authority in the application of standards related to local subdivision streets.

This document is intended for users of the City’s Subdivision Street Requirements for the development of new subdivision streets functionally classified as “local” streets. All other streets must be developed in accordance with appropriate provisions of the VDOT Road Design Manual for the appropriate functional classification.

For the purposes of this document, “City Engineer or assigned designee” means that employee who oversees the land development functions for Neighborhood Development Services (NDS) as assigned by the current City Engineer. In the context of this document, the term can also refer to City Engineer or assigned designee responsible for the review and approval of subdivision street design.

The City Engineer is authorized to consider and render a decision on unresolved issues between the developer and the Engineer that pertain to the interpretation and application of this Manual. All appeals shall be made in writing describing the unresolved issue and include copies of all prior relative correspondence.
All land development proposals should be submitted to the designated NDS Planner.

202 Projected Traffic and Traffic Impact Analysis Report

Proposed developments, rezoning or special use permits have an impact on the transportation system. A Traffic Impact Analysis is required to assess the impact of the proposed development. Requirements for the Traffic Impact Analysis are presented in Chapter 5 Traffic and Transportation in this Manual.

203 Design Requirements

A. Functional Classification

The characteristics and magnitude of the service to be provided will be the basis for the City Engineer’s determination of the functional classification for each subdivision street. AASHTO’s Geometric Design of Highways and Streets provides guidance in the classification of roads.

The hierarchy of the urban functional systems consists of principal arterials (for main movement), minor arterials (distributors), collectors and local roads and streets. A map illustrating the functional classification of the existing roadway network is contained in the Comprehensive Plan.

Local Streets are defined as those streets that provide direct access to adjacent land and serve travel of short distances as compared to the higher functional classifications. Service to through traffic is discouraged. Most subdivision streets fall in the Local Street classification. The geometric design standards contained in this guide should be used for streets classified as local roads. All other street classifications should use VDOT’s Road Design Manual for geometric design.

1. Procedures

The City Traffic Engineer’s concurrence with the functional classification for each street within a subdivision should be made prior to the City’s approval of a subdivision concept plan. To facilitate the effective development of the plats or plans and permit an expeditious review, this concurrence is recommended prior to the initiation of a detailed design for the subdivision. To initiate the functional classification process, the developer should submit the following information:

a. A sketch accurately depicting the general concept for the proposed development of the subdivision, in conformance with the applicable provisions of the governing body’s zoning and subdivision regulations. This sketch should include:
1) The general location and configuration of each street proposed within the subdivision, including the terminus and right of way, including but not limited to anticipated average daily traffic volumes, anticipated percentage of trucks, peak hour traffic volumes, and any proposed phased development of streets.

2) The location and area of each type of permitted land use within the subdivision.

3) The location of any proposed transportation facility, within the subdivision's boundaries, included in the current Comprehensive Plan for the City.

4) The proposed functional classification of each street within the subdivision.

5) Functional classifications of the roadways surrounding the proposed project.

b. Other available information pertinent to the intended development of the subdivision.

c. Any street proposed for phased development should be reviewed at this time and be approved for such development by the City Engineer.

2. Approval

The City Traffic Engineer will provide written concurrence to the appropriate City Department and the developer, if applicable, regarding the approved functional classification for each street in the subdivision. Approval of the conceptual plan or subdivision sketch should be considered concurrence of the functional classification and general layout of the streets. This approval shall be valid as long as the basic concept for the subdivision's development, as submitted for review, remains unchanged.
204 Roadway Geometric Design Criteria

A. Collector And Arterial Roadways

Streets functionally classified as "collector" and "arterial" should be designed in accordance with applicable provisions of the VDOT Road Design Manual.

B. Local Roadways

Any street functionally classified as "local" shall have a minimum design based on the Geometric Design Standards for New Residential Subdivision Streets, Appendix B, Tables 1-3 and other applicable provisions of this Manual. The following criteria shall apply to the design of all subdivision streets functionally classified as "local":

A single-unit (SU) truck design vehicle, as defined by AASHTO, should be used for the design of all local subdivision streets. Dimensions for this vehicle are depicted in Exhibit 2-4 of the AASHTO Geometric Design of Highways and Streets 2001, shown as Figure 2-1.
FIGURE 2-1 – SINGLE UNIT TRUCK DESIGN DIMENSIONS (FROM "A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS," AASHTO, 2001)

- Assumed steering angle is 31.7°
- CTR = Centerline turning radius at front axle
C. Alignment

1. Provision shall be made, when necessary, for the continuation of principal existing or platted streets into adjoining areas.

2. Local streets shall be laid out to conform as much as possible to the topography to increase connectivity, to encourage energy conservation, to discourage use by through traffic, to permit efficient drainage and utility systems and to require the minimum number of streets necessary to provide for safe, convenient access to property.

3. No more than two (2) streets shall intersect at one point unless specifically approved by the Planning Commission.

4. The minimum curb radius at the intersection of two (2) local streets shall be twenty-five (25) feet. The minimum curb radius at an intersection involving a collector street shall be thirty (30) feet. The maximum curb radius should be dictated by the design vehicle for the particular project in question.

5. For rehabilitation of an existing street, the above requirements will be used as guidelines, but designs/redesigns will be approved by the City Engineer on a case by case basis.

D. Transitions And Turn Lanes

1. Left or right turn lanes should be provided at intersections when the City determines that projected turning movements or safety warrants their installation. These facilities shall be designed in accordance with the appropriate provisions of Appendix C of the VDOT Road Design Manual or other traffic analysis tools specifically approved for use by the City Traffic Engineer. Where necessary, additional right-of-way width shall be provided to accommodate these facilities.

2. Normally where roadway section widths change, the centerline should not be offset. The length of the transition should be calculated using the following formula for design speeds less than forty-five (45) mph.

\[ L = \frac{S^2 W}{60} \]

- \( L \) = Length of transition (feet)
- \( S \) = Design Speed (mph)
- \( W \) = Width of offset on each side (feet)
Example: Road narrows evenly about the centerline from thirty-six (36) feet to thirty (30) feet. Width of offset on each side is 3 feet. Design speed is 25 mph.

625 (3) ÷ 60= 31.25 ft

E. Sight Distance

Sight distance standards are presented in Tables 1-3 of Appendix B. Details related to the measurement and types of sight distance are explained below.

1. Stopping Sight Distance - Stopping sight distance shall be based on a height of eye of 3.5 feet and an object height of 2.0 feet along the center of the travel lane.

2. Intersection Sight Distance - Intersection sight distance should be measured presuming a stop condition of the minor roadway. Sight distance shall be based on a height of eye of 3.5 feet and an object height of 3.5 feet. Dedicated right of way may be required to preserve appropriate sight distance at intersections. The City Traffic Engineer may consider an easement as an alternative to dedicated right of way. The Intersection Sight Distance shall be noted on plans.

3. Sight Distance Triangles - The intersection sight distance is measured along the major roadway, based on the major roadway’s design or, in the case of existing roadways, the posted speed limit. Sight Triangles shall be noted on plans.

Decision points (A, B and C in Figure 2-2) represent the position of drivers along the major and minor roadways. Two sight distance triangles are considered, one in each direction of the major roadway from decision point A, which represents the driver exiting the minor roadway.

Decision point A is located four (4) feet from the centerline or left edge of pavement of the minor roadway and twenty (20) feet from the middle of the nearest travel lane of the major roadway. (For reference purposes, AASHTO defines this point as 14.4 to 17.8 feet from the edge of the travel lane of the major roadway.)

Decision point B is located in the middle of the nearest travel lane of the major roadway.

Decision point C is located in the nearest right to left movement lane of the major roadway, four (4) feet from the centerline or the left edge of pavement.
F. Intersections

1. Angle of intersection

Intersections shall be laid out to intersect at right angles; however, intersecting angles between seventy-five (75) and ninety (90) degrees are allowed between two (2) intersecting streets.

A landing, a minimum of fifty (50) feet in length and having a maximum vertical grade of 2%, should be provided at each intersection. Sign islands may be permitted if approved by the City Traffic Engineer.

2. Spacing (i.e. Minimum distance between intersecting roadways) – for Local Streets Only

Offset intersections are discouraged.

Desirable spacing between streets entering from opposing side of the major street is 250 feet. Desirable block lengths, or spacing between streets entering from the same side of the major street is 500 feet. For low volume local streets with ADT <1500 vpd the minimum spacing
between streets entering from opposite sides of the major street should be no less than 125 feet and block length should be no less than 250 feet. Figure 3 illustrates the desirable spacing.

**FIGURE 2-3 – MINIMUM INTERSECTION RADII AND SPACING**

3. Minimum Radii

Normally, intersection radii should be the same on all quadrants of an intersection. However, roadway alignments, traffic volumes along the respective legs, and other factors may warrant consideration of using different radii and may be considered. For subdivision streets the following considerations shall apply:

a. For skew intersections, radii should not be less than twenty-five (25) feet for the acute angle and thirty (30) feet for the obtuse angle of the intersection street.

b. For turns from roadways with less than 1500 vpd onto roadways under 1500 vpd.

1) The minimum intersection radii on subdivision streets should normally be twenty-five (25) feet.
If intercity buses or standard sixty-five (65) passenger school buses are expected to use the street, the minimum radius should be increased to accommodate the turning radius of such vehicles. Minimal encroachment into the opposing lane of traffic on the receiving street is expected. A larger radius or additional pavement at the intersection may be required as determined by the City Traffic Engineer on shoulder and ditch sections to avoid shoulder rutting.

2) When the traffic volume of the receiving street is less than 400 vpd or when a turn lane from the exited street is available, greater encroachment into the opposing lane may be acceptable and a radius not less than fifteen (15) feet may be used. However, when a radius less than twenty-five (25) feet is proposed, an auto-turn diagram should be used to demonstrate the impact of a single unit design truck on the opposing lane of the receiving street and the sufficiency of the street widths to accommodate said vehicle without running off of pavement or scrubbing curbs.

c. For turns from or onto roadways carrying 1500 or more vpd.

The minimum intersection radii shall be that required to accommodate a single unit truck design vehicle without encroaching into the opposing lane of the receiving street. This is typically a thirty foot (30) radius. The sufficiency of the street widths to accommodate said vehicle shall be demonstrated with an appropriate diagram. If intercity buses or standard sixty-five (65) passenger school buses are expected to use the street, the minimum radius shall be increased as necessary to accommodate the turning radius of such vehicles. Minimal encroachment into the opposing lane of traffic of the receiving street is expected.

G. Grades

1. The maximum allowed street grade without special approval shall be eight (8) percent.

2. The Planning Commission may allow grades in excess of eight (8) percent up to ten (10) percent where it determines that such a street grade will permit better lot arrangements with less adverse environmental impact.

H. Street Names

1. Where a street is planned as a continuation of an existing street, such street will bear the same name.
2. New street names shall be sufficiently different from existing street names in the City of Charlottesville or Albemarle County to avoid confusion.

3. The developer shall furnish and install one (1) street name sign per street at new intersections. Street name signs shall meet the requirements of Traffic and Transportation Chapter 5 in this Manual.

205 Elements of a Typical Section

A. Pavement Design

1. Pavement design for new subdivision streets shall be developed using the VDOT Pavement Design Guide for Subdivision and Secondary Roads in Virginia.

2. Blotted seal pavements should have a crown of 3/8 inch per foot.

B. Pavement Width

1. Design - General

   a. The minimum acceptable widths of right-of-way, paved surface and adjacent elements for newly constructed streets of various categories are presented in Roadway Typical Sections and Tables provided in Appendix B.

   b. Concrete curbs, or combination curb and gutter, of city standard design shall be installed at the limits of the paved surface on both sides of new streets, and concrete sidewalk at least five (5) feet wide exclusive of curbing and constructed to city standards shall be provided on both sides of every new street unless the Planning Commission waives sidewalk on one (1) side. Please note that a waiver for sidewalk is not a waiver for curb. Curb or combination curb and gutter may still be required for drainage. The commission shall base its decision on such waivers upon the criteria for establishing sidewalk construction priorities set forth in the comprehensive plan of the city. In all instances the dedicated right-of-way shall be sufficient to permit installation of sidewalk on both sides of the street.

2. The typical design criteria for each street should be uniform between intersections.

   The Engineer may consider modifications as required to satisfy changes in traffic volume or as necessary to address environmentally sensitive areas.
3. Roadway designs should be broadly based on three (3) categories in Appendix B:
   a. Curb and Combination Curb and Gutter Design, further defined by the land use served by the street – residential or non-residential.
   b. Shoulder and Ditch Design.
   c. One-way street design.

4. Except as may be permitted in this subsection, the minimum pavement widths should be as shown in Tables 1 through 4 in Appendix B.

5. Unless otherwise indicated, the use of curb or combination curb and gutter anticipates on street parking. Parking along streets with shoulder and ditch design is normally considered prohibited.

C. Parking Lane Widths (With Curb or Combination Curb and Gutter Only)

1. The use of curb and gutter anticipates on-street parking will be accommodated, using the following widths for the parking lane:

   Residential Streets – seven (7) feet in width measured from the face of curb.

   Commercial and mixed use – eight (8) feet in width measured from the face of curb.

D. Concentric Design

Normally, the design of principal roadway elements of subdivision streets should be concentric about the center of the right-of-way. However, certain circumstances and special development goals, such as phased development may justify arrangements that require one side of the right of way to differ from the other, when based on a typical centerline between travel lanes. The normal typical section may be varied as necessary to provide for vehicular or pedestrian safety or both and traffic channelization features, e.g., turn lanes, intersection radius, etc.

E. Cul-De-Sacs And Turnarounds

To afford the greatest flexibility in design, various types of turnaround designs may be used on subdivision streets.

Additional right-of-way shall be provided as required by the turnaround design to continue the right of way limits around the perimeter of the turnaround. Acceptable Cul-de-sac designs include:
1. Circular Type Turnarounds

For circular turnarounds, a well-defined identifiable street segment, equal to the normal lot width along the intersected street that serves the cul-de-sac or fifty (50) feet whichever is greater, shall extend from the intersected street to the turning area. A minimum radius of forty (40) feet, measured to the edge of pavement or face of curb shall be used.

2. Cul de sacs with unpaved centers (Islands) (as shown in Figure 2-4)

When a circular turnaround is proposed with an unpaved area in the center, the roadway around the center should be considered a one-way street and designed according to Table 3 in Appendix B. Pavement widths may be increased by the City Traffic Engineer to accommodate turning radii of single unit truck design vehicle. Cul-de-sacs with curb and gutter should have a roll-top curb along the circumference of the island.

The unpaved area should have a minimum radius thirty (30) feet as shown in Figure 2-4. Any non-travel areas included within turnarounds should be included in the dedicated right-of-way of the facility.

If the center radius is greater than 120 feet, the street will be considered a loop street and should be designed in accordance with tables in Appendix B.

   a. Sidewalk and curb built to city standards shall be installed around the open circumference of the cul-de-sac. No cul-de-sac street shall exceed 700 feet in length, excluding the turnaround.

   b. Streets that terminate temporarily and thereby take on the character of a dead-end street shall be provided with a turnaround having a diameter of not less than seventy (70) feet, or a "T" type turnaround approved by the City Traffic Engineer and the City Fire Chief.

   c. Alleys of not less than twenty-two (22) feet in width shall be provided in the rear of all business and industrial district lots. No dead-end alleys shall be permitted. The Planning Commission may waive this requirement if, in its opinion, other provisions will satisfactorily meet the access needs of the subdivision.

3. Alternative Turnarounds (for Residential streets only)

"T and Branch" type turnarounds may be considered for short streets less than 0.25 miles in length. Examples are shown in Figure 2-4. Other proposals must be judged on their merits by the City Traffic Engineer and the City Fire Chief. However, when proposed, the ability of single unit truck design vehicles to reverse direction on these alternative types of turnarounds, without leaving the pavement area should be proven.

4. Temporary turnarounds and stub streets
A turnaround should be provided for any temporary or stub street longer than 150’ from the point of intersection to the end of pavement. Any portion of the turnaround outside the dedicated right of way for the stub street may be placed in an easement.

**CONCENTRIC CUL-DE-SAC**

**OFFSET CUL-DE-SAC**

**60’ HAMMERHEAD**

**120’ HAMMERHEAD**

**ACCEPTABLE ALTERNATIVE TO 120’ HAMMERHEAD**

**FIGURE 2-4 – CUL-DE-SAC DETAILS**

F. Curb and Gutter Designs
The City does not require the use of curb and gutter on subdivision street acceptance for LID’s but recognizes that it is an acceptable design alternative and preferred in high density developments. Curb and gutter details and cross-sections shown in Appendix A and B are appropriate for Subdivision streets.

The following notes apply to CG-2, CG-6 and Rolltop curb:

1. When used with stabilized, open-graded drainage layers, the bottom of the curb and gutter shall be constructed parallel to the slope of the sub-base courses and to the depth of the pavement but not less than the thickness shown.

2. Use of curb and gutter has a direct relation to the design speed of the roadway of which it is a part, as follows:

   a. CG-2 and CG-6 may be used in urban and suburban settings (including subdivisions) on streets having a design speed not greater than forty-five (45) mph. When used along rural highways, CG-6 shall be limited to design speeds not greater than forty (40) mph.

   b. Rolltop curb and gutter may be used along subdivision streets having a design speed not greater than thirty (30) mph.

3. All curb and gutter designs shall transition to match entrance gutters or another curb and gutter type or standard curb openings within ten (10) feet of the change in gutter type.

4. Curb ramps

   All streets that incorporate accessible routes for pedestrian use shall include curb ramps at intersections for use by persons with disabilities, without regard to the curb design used. Curb ramps should be constructed in accordance with Standard CG-12. See Appendix A, CG-12 Detectable Warning Surface. Further guidance on the design of curb ramps may be found in VDOT Location and Design IIM–LD–55.

5. Treatment behind curbs

   a. Where curb and gutter is used, a 1/4 inch per foot (2%) graded area, at least three (3) feet in width, should be provided behind the back of curb.
b. Where sidewalk is used in conjunction with curb and gutter, planting strips shall be included behind the curb as shown in Figure 2-5.

c. Major subdivisions will be required to have planting strips on all new public streets.

*FIGURE 2-5 – DETAIL BACK OF CURB*

G. Private Entrances

1. Curb and combination curb and gutter private entrances

At all driveway entrances, a standard entrance (Std. RE-1 and RE-2, Appendix A) shall be used with Standard CG-2 and CG-6. A special design entrance gutter shall be submitted to the City Engineer for approval when roll-top curb is used, similar to that shown in Figures 2-6 and 2-7.
Part Plan of Entrance Transition

FIGURE 2-6 – ROLL-TOP CURB ENTRANCE DETAIL

Part Section A-A

FIGURE 2-7 – ROLL-TOP CURB ENTRANCE DETAIL SECTION
2. Ditch section private entrances

All private entrances over ditches shall be designed to serve individual lots on a local subdivision street. All private entrances over ditches should be designed and constructed as shown in Figure 2-8. Entrance radius should be twenty (20) feet except in high density areas where a twelve (12) feet radius can be allowed. All entrance pipe culverts will be sized to accommodate the runoff expected from a 10-year frequency storm.

All entrance grades shall start back of the shoulder line. If drainage is necessary, the ditch line may be moved back to provide cover for pipe. Entrances shall be at least twelve (12) feet wide and shall be tied into the roadway smoothly. The driveway entrance surface shall extend from the edge of the roadway to the right of way line. Entrance surface can be crusher run aggregate or paved.

3. Driveway entrance grades

In the interest of assuring an adequate, convenient, and safe access to public roads, the grades along driveways shall not exceed eight percent (8%).

**FIGURE 2-8 PRIVATE ENTRANCE DETAIL**

Notes:
See VDOT Road and Bridge Standards, Std. PE-1 for cut/fill details.

All entrance grades shall start back of the shoulder line.

If drainage is necessary, the ditch line may be moved back to provide 9 inches (min.) cover over pipe.

Entrances shall be 12 ft wide and transition smoothly into the roadway surface. Driveway entrance pavement shall extend to the right of line. When an existing street is re-developed and modification of an existing driveway entrance is required, the entrance pavement shall be extended to the right of way line or the extent of disturbance to the existing driveway.

Desirable Radius Note:
For entrances to roadways having ADT of 2000 or more, use radius of 20 feet. For ADT under 2000 radius may be 12 feet.
H. Hydraulic Cement Concrete Construction

Hydraulic Cement Concrete (Concrete) used in the construction of roadway elements shall meet the requirements of VDOT Road and Bridge Specifications, current edition, Section 217 – Hydraulic Cement Concrete. Concrete mix requirements for construction in the City of Charlottesville are presented in Table 2-1 below.

### TABLE 2-1

CONCRETE MIX REQUIREMENTS

<table>
<thead>
<tr>
<th>Class</th>
<th>Design Strength (1)</th>
<th>Cement (2)</th>
<th>Fine Aggregate (3) (4)</th>
<th>Coarse Aggregate (3) (4)</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>A3</td>
<td>3000 psi</td>
<td>588 lb/cu yd</td>
<td>1362 lb/cu yd</td>
<td>1811 lb/cu yd</td>
<td>33.5 gal/cu yd</td>
</tr>
<tr>
<td>City Mix (9)</td>
<td>3500 psi</td>
<td>588 lb/cu yd</td>
<td>1260 lb/cu yd</td>
<td>1811 lb/cu yd</td>
<td>33.5 gal/cu yd</td>
</tr>
<tr>
<td>A4</td>
<td>4000 psi</td>
<td>635 lb/cu yd</td>
<td>1219 lb/cu yd</td>
<td>1811 lb/cu yd</td>
<td>33.5 gal/cu yd</td>
</tr>
<tr>
<td>Flowable Fill</td>
<td>30 psi</td>
<td>(10)</td>
<td>(10)</td>
<td>--</td>
<td>(10)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Class</th>
<th>W/C Ratio (5)</th>
<th>Fly Ash</th>
<th>AE Range (6)</th>
<th>WR (7)</th>
<th>HRWR (8)</th>
<th>Slump Range Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>A3</td>
<td>0.56</td>
<td>--</td>
<td>6 +/- 2%</td>
<td>--</td>
<td>--</td>
<td>1-5&quot;</td>
</tr>
<tr>
<td>City Mix</td>
<td>0.49</td>
<td>Not allowed</td>
<td>6 +/- 2%</td>
<td>--</td>
<td>--</td>
<td>1-5&quot;</td>
</tr>
<tr>
<td>A4</td>
<td>0.45</td>
<td>--</td>
<td>6 +/- 1%</td>
<td>--</td>
<td>--</td>
<td>2-4&quot;</td>
</tr>
<tr>
<td>Flowable Fill</td>
<td>(10)</td>
<td>(10)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>8-10&quot;</td>
</tr>
</tbody>
</table>

**NOTES:**

(1) Minimum compressive strength in psi at 28 days.
(2) Minimum amount of Type I or Type II Portland Cement per ASTM C-150.
(3) Saturated surface dry weight.
(4) #57 size manufactured and tested for acceptance by ASTM C33 and The Virginia Department of Transportation Road and Bridge Specifications.
(5) Maximum water - cementitious ratio by weight.
(6) AE is percent air-entrainment. AE admixtures to meet or exceed requirements of ASTM C-260 and AASHTO M-154.
(7) WR is water-reducer admixture. WR admixtures to meet or exceed requirements of ASTM C-494 and AASHTO M-194.
(8) HRWR is high-range water-reducer admixture. HRWR admixtures to meet or exceed requirements of ASTM C-494 Types A & F and AASHTO M-194 Types A & F.
(9) “City Mix” to be colored “Omaha Tan” using Rockwood Pigments/Davis Colors #5084. “City Mix” shall meet requirements of VDOT A3.5 concrete unless otherwise indicated.
(10) Mix design shall be submitted for approval with laboratory test data verifying compliance with 28-day compressive strength requirements. Mix design shall be approved by the City Engineer prior to placement.
I. Asphalt Paint

Upon special request and review/approval by City Engineer, Traffic Engineer, or assigned designee, asphalt may be used in certain instances as a replacement for concrete. In some cases the asphalt will need to match a concrete color. Acceptable paint type is Streetbond CemBase 150 (item number SBRH-CB150-B1) Streetbond Colorant. To find use [www.integratedpaving.com](http://www.integratedpaving.com) or similar company if available. (click on Streetprint). Purchaser must be a licensed applicator.

206 Minimum Street Improvements Required

A. Any newly constructed street in a subdivision shall be paved to the width specified in Appendix B. Such paving shall consist of aggregate base material used as sub base with a thickness of at least six (6) inches after proper compaction and an asphalt base course with a thickness as determined by the approved pavement design. The developer must construct the asphalt base course before any CO’s (Certificate of Occupancy) are issued. The asphalt surface course shall be applied at the developer’s cost only after the City staff has determined that eighty percent (80%) of the site is completed. Where topography, soils or anticipated traffic conditions make it necessary, the City Engineer may require a greater thickness of aggregate base material.

B. The applicant for a subdivision or site development fronting on an existing street shall make the following improvements:

1. If such subdivision or site development fronts on an existing City street without a sidewalk along its frontage, the applicant shall construct a sidewalk at least five (5) feet wide exclusive of the curb according to City Standards along such frontage. The Agent may waive this requirement and shall base decisions on such waivers on the criteria for sidewalk construction set forth in the City Code, Chapter 29 Subdivisions, Section IX.

2. If a subdivision fronts on a dedicated right-of-way which is unaccepted and unimproved, the applicant shall develop such street according to the standards set forth in this Manual.

207 Provisions for Bus Stops

Where the proposed subdivision or site development fronts on an arterial or collector street which has bus routes, the Planning Commission may require that adequate land be dedicated to permit installation of a turnout lane or bus stop and a bench or shelter.
208 Monuments

A. Permanent concrete monuments shall be placed at all block corners or at the
tangent points of curves connecting intersecting street lines, at the points of
curvature and tangency, at all corners in the exterior boundary of the
subdivision except at such corners that are inaccessible due to topography,
and at such other points as may be designated by the Planning Commission.
The location and character of all such monuments shall be clearly designated
on the final plat. Such monuments shall be set flush with the surface of the
ground or finished grade.
Monuments shall be pre-cast concrete two (2) feet in length and four (4)
 inches square or eight (8) inches in diameter, having a metal pin imbedded
therein. The monuments may be a steel or iron pin five-eighths of an inch by
thirty (30) inches or larger, set in a block of concrete eighteen (18) inches
deep and ten (10) inches square at top and bottom, marking the points
represented on the final plat.

B. The applicant shall certify in writing that the monuments have been accurately
placed throughout the subdivision as required before the streets may be
accepted for maintenance or the performance bond or other guaranty
released.

209 Pedestrian and Bicycle Facilities

A. General

1. Sidewalks proposed for City maintenance shall be completely contained
within the right of way. Sidewalks should generally conform to the vertical
alignment of the adjacent roadway.

2. Sidewalks shall be a minimum of five (5) feet in width. Sidewalks shall be
designed in accordance with ADA requirements and VDOT’s Location and
Design Instructional Memoranda IIM-LD-55, Curb Ramps and Sidewalks.

3. Sidewalks shall not be less than four (4) inches thick, except when used in
conjunction with roll top curb, in which case the thickness shall be seven
(7) inches. See Appendix A, City Standards SW-1, SW-2, Figure 2-6,
Roll-Top Curb Entrance Detail and Figure 2-7, Roll-Top Curb Entrance
Detail Section.

4. If trees are to be planted between the curb and the sidewalk, the sidewalk
shall be not less than six (6) feet behind the back of curb with the trees
planted so that the center of the tree trunk is not less than three (3) feet
behind the curb as shown in Figure 2-5. Types of trees vary with ROW
widths. Please refer to City of Charlottesville Master Tree List available in
the NDS office and available on the NDS web site.
5. Sidewalks located on a fill section requiring guardrail shall be located in front of the guardrail.

B. Sidewalks along curb and gutter streets

1. Sidewalks along curb and gutter streets shall be constructed with hydraulic cement concrete sidewalk or solid paving units.

2. Concrete sidewalks shall be constructed in accordance with this Manual.

3. Solid paver unit sidewalks shall be constructed in accordance with VDOT’s Location and Design Instructional & Information Memoranda IIM-LD-218, Paver Units (Sidewalk and crosswalk) and in accordance with VDOT’s Road and Bridge Standards.

C. Sidewalks along ditch section streets

1. Sidewalks along ditch section streets shall be constructed in accordance with this Manual and VDOT’s Road and Bridge Specifications for asphalt concrete sidewalk or hydraulic cement concrete sidewalk, on a compacted subgrade.

2. Sidewalks constructed along a shoulder and ditch section shall be placed behind the ditch in a manner that will be compatible with the roadway if the roadway is converted to a curb and gutter section. (Note: Construction of sidewalk within the shoulder area is not permitted.)

3. On shoulder and ditch sections, construction of sidewalk within the prescribed shoulder area of the roadway will not be permitted.

D. Bike/Multi-Use Trails

1. Shared use trails are paved facilities within the right-of-way with minimal cross flow by motor vehicles. Users of these trails may include bicyclists, inline skaters, roller skaters, wheelchair users (motorized and non-motorized) and pedestrians including walkers, runners, people with baby strollers and people walking dogs. Bike/Multi-Use Trails are most commonly designed for two-way travel and the following guidance assumes a two-way facility.

2. When two-way shared use trails are located adjacent to a roadway, wide separation is desirable to demonstrate to both the bicyclist and the motorist that the path functions as an independent facility for bicyclists and others. For curb and gutter streets, the bike/multi-use trail shall be a minimum of 6 feet from the back of the curb.
3. The minimum pavement width for a bike/multi-use trail shall be ten (10) feet. A minimum two (2) foot wide graded shoulder should be maintained adjacent to both sides of the trail. A minimum three (3) foot clear zone should be maintained from the edge of the trail. Where the trail is adjacent to slopes steeper than 3:1, a five (5) foot wide shoulder is needed. The vertical clearance should be a minimum of eight (8) feet. However, vertical clearance may need to be greater to permit passage of maintenance and emergency vehicles. In under-crossings and tunnels, a 10-foot vertical clearance is desired.

4. Bike/Multi-Use Trails should be designed for a selected speed that is at least as high as the preferred speed of the faster bicyclists. In general a design speed of twenty (20) mph should be used. Long grades should be kept to a minimum. Grades greater than five percent (5%) are undesirable because the ascents are difficult for many bicyclists to climb and the descents cause some bicyclists to exceed the speeds at which they are competent or comfortable. In locations where grades exceed five percent (5%), Table 2-1 shows recommended maximum grade lengths.

### TABLE 2-2

<table>
<thead>
<tr>
<th>Grade</th>
<th>Maximum Length</th>
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</thead>
<tbody>
<tr>
<td>5 – 6%</td>
<td>800 feet</td>
</tr>
<tr>
<td>7%</td>
<td>400 feet</td>
</tr>
<tr>
<td>8%</td>
<td>300 feet</td>
</tr>
<tr>
<td>9%</td>
<td>200 feet</td>
</tr>
<tr>
<td>10%</td>
<td>100 feet</td>
</tr>
<tr>
<td>11+%</td>
<td>50 feet</td>
</tr>
</tbody>
</table>

See City Standard BT-1 Bike/Multi-Use Trail Pavement Section in Appendix A. Further design details for bike/multi-use trails may be found in Section A-5 Bicycle Facility Guidelines of the VDOT Road Design Manual.

E. Pedestrian tunnels

1. Pedestrian tunnels to separate pedestrian crossings from roadway traffic are being encouraged by some localities to improve pedestrian safety on high volume streets. The Subdivision Street Requirements provide criteria for City acceptance of these pedestrian tunnels under certain conditions. All underpass structures intended for pedestrian use, whether they are
accepted for maintenance as part of the roadway or accepted under the terms of an agreement should have the following characteristics:

a. Have entrances visible from the side of the roadway above.

b. Be aligned to the pedestrian corridor such that the interior of the tunnel is visible to pedestrians from a distance of not less than twenty-five (25) feet and preferably for its entire length.
c. If located at a school, be equipped with security gates so that school authorities may regulate the hours it is available for use.

2. All underpass structures intended for acceptance of maintenance by the City or VDOT as an integral part of the roadway, should also include the following:
   a. Have a grade not greater than three percent (3%).
   b. Have a non-skid paved surface comparable to the finish of a sidewalk.
   c. Have continuous handrails.
   d. Have a clear height not less than 8 feet.
   e. Have a clear width, exclusive of any area used or reserved as a utility corridor, not less than ten (10) feet.
   f. Have security lights with explosion proof fixtures if the tunnel is more than twenty-five (25) feet in length or if the tunnel is available for use after dark.
   g. Be accessible to persons with disabilities from sidewalks associated with the roadway above or, as an alternative, by a circuitous route.
   h. Pedestrian ramps should be provided at all pedestrian separation structures.
   i. When warranted and possible, a stairway can be provided in addition to a ramp. Ramps should be deleted only when it would be infeasible for mobility-limited persons to reach the pedestrian separation structures due to unusual topographical or architectural obstacles or when alternate safe and reasonably convenient means are provided to cross the highway.
   j. The ramp should have a maximum slope of 12:1 with a maximum rise of thirty (30) inches between landings. Landings should have a minimum length of five (5) feet and should be of sufficient width to allow wheelchairs to maneuver.

F. Bicycle Lanes

On local streets, bicyclists should be considered a normal part of the vehicle mix on the street. Bike lanes should be one-way facilities and carry bike traffic in the same direction as adjacent motor vehicle traffic.
The minimum width of a bike lane is five (5) feet from the face of a curb to the bike lane stripe. If parking is permitted, the bike lane should be placed between the parking area and the travel lane and have a minimum width of five (5) feet. Bike lanes should never be placed between the parking lane and the curb line or sidewalk.

Further design details for bicycle lanes may be found in Section A-5 Bicycle Facility Guidelines of VDOT’s Road Design Manual.

210 Right-Of-Way

A. Width

The minimum right of way shall be the width necessary to accommodate all roadway elements, including the suggested clear zone, to be maintained as part of the roadway. In no case shall the right-of-way extend less than one foot behind any feature to be maintained by the City or VDOT however, easements may be used in lieu of dedicated right-of-way to accommodate slopes or sight distances. Reduced right-of-way may be allowed with specific approval of the City Engineer.

Dedicated right-of-way for roadways to the extent they occupy dams is not acceptable. All such right-of-way shall be platted as an ingress/egress easement.

B. Spite strips

Plans that include a reserved or "spite" strip which prohibits otherwise lawful vehicular access to a street from the adjacent properties, whether within or outside the subdivision, will not be approved.

211 Other Design Considerations

A. Clear Zone (i.e. Setback for non-breakaway fixed objects)

The right of way along new public streets and highways maintained by the City must remain clear of all obstacles that are not designed to break away under impact. For the purposes of this section, breakaway structures are defined as a single, four inch x four inch (4”x4”) square or four (4)-inch diameter wooden post or a standard strength, metal pipe post no greater than a two (2)-inch diameter.

When curbing is used, the clear zone is measured from the face of the curb, except where a bike lane or parking lane exists between the curb and the traveled way.
In such a case, clear zone may be measured from the edge of the traveled way. For shoulder and ditch sections, clear zone is measured from the edge of pavement. Approved mailboxes and newspaper boxes may be placed on the City's right-of-way. Placement should not interfere with safety, maintenance and use of the roadway or sidewalk. Support structures for multiple mailboxes shall be designed and constructed in accordance with VDOT's Road and Bridge Standard RFD-1. However, lightweight newspaper boxes may be mounted on the side of the support structure. Breakaway structures noted above will be acceptable as a mailbox post.

Traffic volume, operational or design speed of the street, and the typical cross section of the street determines the required clear zone. The geometric design Tables 1, 2, 3 and 4 in Appendix B provide suggested clear zone requirements for subdivision streets. Any structures or landscaping, including fences, stone or brick mailbox posts, columns or walls that do not meet breakaway requirements may not be located within the clear zone and will require review by City Engineer to be placed on the right-of-way. Refer to Figures 2-9 and 2-10 for visual layout of setback details.
Note: Driveway entrance curbing, regardless of height, shall not be permitted past sidewalks or within the area three (3) feet behind curb and gutter.

FIGURE 2-10 – SETBACK DETAILS WITH SHOULDER AND DITCH

Non-breakaway structures should be placed off Right of Way (RW) or, if on RW, must be outside of clear zone under VDOT land use permit.
B. Guardrail

Guardrail shall be provided and installed by the developer as necessary for the safety of the traveling public as determined by the City Engineer. Plans should indicate proposed guardrail location. Generally, when fill slopes are 3:1 or flatter, a barrier is not required unless there are hazardous obstacles within the clear zone limits. The developer is encouraged to examine alternatives that eliminate potential hazards in order to avoid the need for guardrail.

In urban and suburban settings with speeds of forty-five (45) mph or less that include curb or curb and gutter, the use of guardrail is not recommended. Standard CG-6 is normally used in these areas and is referred to as barrier curb because it has a six (6) inch vertical face and is intended to discourage motorists from deliberately leaving the roadway. Even when mountable curb is used in suburban settings, it is impractical to install guardrail in an attempt to protect pedestrians walking along sidewalks due to the lack of accessibility caused when placing guardrail and terminals adjacent to accessible routes. Sometimes hazards, such as ponds or steep embankments, which need to be shielded, exist on subdivision streets with sidewalk/sidewalk space. In situations like this, guardrail can be placed behind the sidewalk.

The use of guardrail types that are aesthetically compatible with the surrounding areas should be considered. One acceptable type is "Corten" or weathering steel rail with treated timber post. Alternate types may be considered provided they (i) conform to applicable City and VDOT standards or the criteria prescribed in the National Cooperative Highway Research Program Report 350, (ii) blend in with their surroundings and (iii) do not create an undue maintenance problem.

C. Traffic Control

All plans should indicate appropriate traffic control signage and devices as designated by the Manual for Uniform Traffic Control Devices (MUTCD) and the Virginia supplement to the MUTCD. See Chapter 5 Traffic and Transportation.

D. Streetscape

Development trends promote the use of trees, sidewalks, bicycle facilities, and shared paths adjacent to but typically set back from vehicle corridors. Trees may also be proposed within unpaved medians and center islands in cul-de-sac designs. Landscaping within the right of way is often allowed and maintained by the requestor. See Appendix G, Landscape Planting Specifications.
Planting strips, located between the curb and sidewalk and parallel with the street, shall be six (6) feet or more in width as shown previously in Figure 2-5. Care should be used to ensure that larger planting strips do not push pedestrian crossing areas back from the intersections by requiring a larger curb radius. On streets with design speeds of thirty (30) mph or less, or on streets with on-street parking, small street trees may be planted within three (3) feet of the back of the curb and should generally be planted along the centerline of the planting strip. To maintain sight lines, trees and other objects should be restricted from corners for distances of thirty (30) feet on all sides. Along all planting strips, the area between two (2) and seven (7) feet above ground should be maintained as a clear zone to preserve sight lines and accommodate pedestrians.

Trees, landscaping, and other encroachments onto the right of way can obscure pedestrians or other vehicles preparing to enter the roadway from adjacent property or side streets. To protect the safety of pedestrians, bicyclists, and motorists alike, it is appropriate for vehicle operators to have an unobstructed view along the full length required by the sight distance triangle. On-street parking is considered a temporary condition and is an exempt factor.

When trees are planted along streets, especially in association with sidewalks, species selection is critical. When attracted to fruits, nuts and berries produced by some species, congregations of birds may cause potentially undesirable conditions for pedestrians. Also, species that leach sap tend to damage the finishes on parked cars and, when wet, the leaves of some species may damage automotive finishes.

E. Traffic Calming

During street layout and design, the issue of traffic calming should be considered on local streets only. Early consideration can minimize future speeding problems and improve the livability of the neighborhood. If the street layout cannot be designed to encourage target speeds, traffic calming treatments may be appropriate. The type of treatment chosen for incorporation in the design depends on the function and traffic volume of the roadway segment.

1. Design Considerations
   Subdivision streets should be designed to encourage 85th percentile speeds in the range of twenty (25) to thirty (30) mph. This can be accomplished with attention to three major design areas – the width of the paved roadway surface, the length of tangent sections and the vertical grade.
a. Width of Pavement

The width of pavement should be the minimum to safely accommodate the proposed traffic and emergency services. If this is not practical for other reasons, the road width can also be restricted at specific points through the use of chokers or raised median islands.

b. Tangent Lengths

Tangent lengths should ideally not exceed 500 feet. Studies indicate that operating speeds were thirty (30) mph or less when the tangent sections were no longer than 500 feet. Long tangent sections can be segmented by conditions that require reduced speeds such as a traffic calming device. Devices that are suggested for new subdivisions with an average daily traffic between 600 and 4,000 vehicles per day include roundabouts, chokers, raised median/island, crosswalk refuges or raised pedestrian crosswalks.

c. Grade

Steep downgrades should be avoided in subdivision street design as vehicle speeds tend to increase on downward slopes and vehicles can quickly exceed desirable speeds. Speed humps should be avoided in favor of raised crosswalks. All-way stop conditions are to be used where warranted only due to the tendency for the stop to be ignored and the potential to train drivers that all-way stops don’t really mean “stop.” Any proposal for four-way stops must be approved by the City Traffic Engineer.

2. Types of Traffic Calming

Design details for all types of traffic calming measures may be found in the City of Charlottesville Traffic Calming Device Implementation Guidebook Technical Guidelines and Traffic Calming Guide. Since the Traffic Calming Guide primarily represents retrofit designs, not all traffic calming design features in the guide are appropriate for new construction. Figure 2-11 illustrates certain types of traffic calming treatments.
a. Curb Extensions

Curb Extensions are extensions of the curb toward the travelway and usually found on higher volume streets where they are used to protect parking areas or reduce pedestrian crossing times. See Figure 2-12 for an illustration of a curb extension.
b. Chokers

Curb extensions placed at opposite sides of each other along the roadway are called “chokers”, “pinch points”, or “slow points”. Chokers narrow a road over a short distance.

c. Raised Medians

Medians are islands located along the roadway centerline that separate opposing traffic movements. Medians can provide special facilities to accommodate pedestrians and bicyclists, especially at crossings of major roadways. Raised medians can be island barriers. Such islands are often referred to as refuges.

d. Raised Crosswalks

A raised crosswalk is a raised hump in the roadway with a flat top ten (10) feet wide extending across the road at right angles to the direction of traffic flow.

e. Chicanes

Chicanes are mainline deviations to deter the path of travel so that the street is not a straight line by the installation of offset curb extensions. Examples of chicanes are curb extensions, parking bays, street furniture, landscaping, or other physical obstructions along a straight roadway.
f. Roundabouts

Roundabouts are used at intersections to control traffic as well as to calm traffic. Operational and safety characteristics of roundabouts should be compared with those of signalized and unsignalized intersections on all projects and be used if deemed appropriate. Proposed designs should be based on Federal Highway Administration Publication Number FHWA-RD-00-67, Roundabouts: An Informational Guide. Additional information can also be found in VDOT’s Roundabout Brochure. See Figure 2-13 Roundabout Details. When roundabout design is proposed, the Applicant should consult the City Traffic Engineer.

Common characteristics of acceptable roundabouts include (a) a domed center that is sufficiently clear to not compromise sight distance and (b) a paved traversable apron not less than four (4) feet in width, the radius of which is sufficient to serve the turning radius of school buses and single unit design vehicles. If the percentage of trucks anticipated to use the road exceeds five percent (5%), that radius should be sufficient to serve those vehicles.
FIGURE 2-13 – ROUNDABOUT DETAILS

212 Utilities

All utility locations should be indicated on the plans. Utility lines should be located to minimize need for later adjustment and to permit servicing such lines with minimum interference to traffic or destruction of roadway surfaces.

A. Underground utilities

The City allows the placement of underground utilities within the dedicated right of way of streets.

Underground utilities should normally be located outside of the travel lanes and desirably beyond the pavement.

When location of the utilities outside of the pavement area is not practical and is endorsed by the City such installations:

1. Are acceptable within the parking area and the shoulders along the street.
2. May be acceptable beneath the travel lanes of the street when provisions are made to ensure adequate inspection and compaction tests and when longitudinal installations and manholes are placed out of the wheel path.

3. Open-cutting of hard-surfaced roadways

The City avoids the open-cutting of hard-surfaced roads whenever possible, except in extenuating circumstances. Therefore, all underground utilities within the right-of-way, as determined necessary by good engineering practice to serve the complete development of adjacent properties, shall be installed during the street's initial construction and prior to the application of its final pavement surface course. This shall include extensions of all necessary cross-street connections or service lines to an appropriate location beyond the pavement and preferably the right of way line.

In the event it is necessary to open the street pavement to work on utilities after the surface has been placed, additional compaction tests and paving as necessary to restore the integrity and appearance of the roadway may be required at the discretion of the Engineer.

4. Cross-street conduits

To facilitate the placement of future underground utilities, cross-street conduits are encouraged with placement of such conduits occurring on each street at intersections and approximately every 1000 feet along the length of a street.

B. Above ground utilities

All above ground utilities shall be installed behind the sidewalk or as close as possible to the limits of the street's right-of-way. The Subdivision Ordinance prohibits above ground utilities in new subdivisions.

213 Innovative Design Proposals

This Manual sets out design criteria and guidance for local subdivision streets based on standards and other applicable design references. If a development proposes use of a recognized acceptable concept or material not previously approved for City use, a request shall be submitted to the City Engineer or designee for review. The City Engineer or designee, through consultation with appropriate divisions, will determine if the request will be approved for a City maintained street. If it is determined that the non-standard item may be installed within the dedicated right of way and should be maintained by others, written approval will be required.
CHAPTER 3 – STORMWATER MANAGEMENT

300 Intent and Purpose

1. City of Charlottesville requires all new land development and redevelopment projects that exceeds 6,000 square feet of land disturbance (including, but not limited to, single family lots, site plans, building permits, road plans, and subdivisions) to provide appropriate stormwater management measures such that post-development water quantity does not increase and water quality does not decrease when compared to the pre-development conditions.

   • All sites with land disturbance over one acre must submit a stormwater management plan as defined by Chapter 3 of the City Standards and Design Manual, and a Stormwater Pollution Prevention Plan that adheres to the requirements of the most recent edition of the Virginia Stormwater Handbook.

   • The water quality requirements will be split on a two-tier system: Sites with land disturbance between 6,000 square feet and one acre will use the Average Land cover condition as defined in the current 1999 Virginia Stormwater Management Handbook. Sites with land disturbance over one acre will use the Average Land Cover Condition as stated in the most recent version of the Virginia Stormwater Handbook.

2. The stormwater drainage system in any construction project shall be separate and independent of any sanitary sewer system. All necessary drainage facilities shall be constructed to provide for the adequate conveyance of surface runoff and to maintain any natural drainage course as well as to improve the water quality that may be affected by increased runoff from the site. Drainage analysis and design shall be completed based on standard engineering practices through a Comprehensive Stormwater Management Plan prepared by the developer of the site and submitted for review, recommendations and final approval by the City Engineer.
301 Best Management Practices

Excerpts from Director of NDS memo dated October 31, 2005:

The City Council of the City of Charlottesville adopted a water protection ordinance that contained upgrades to the stormwater management codes and the erosion and sediment control ordinance. Since that time work has been ongoing to develop a best practices manual to guide developers in the implementation of those ordinances.

Effective January 1, 2006, all projects for development submitted to the City of Charlottesville must utilize best management practices for the control of stormwater. This means that any project submitted for review after January 1, 2006 must utilize best management practices.

302 Preliminary Stormwater Management Plan

Any site exceeding 6,000 square feet in land disturbance requires applicants to submit a preliminary drainage study to include:

1. A topographic sketch of the drainage area for pre- and post-development. Drainage area should include the surrounding area draining to that site as well as the actual site itself.

2. Pre-development and post-development runoff calculations for a 2-year and 10-year storm event for that site. If the post-development runoff (rate, volume, or velocity) is greater than the pre-development runoff (rate, volume, or velocity), a comprehensive stormwater management plan to handle the additional runoff is required. Requirements for Final Stormwater Management Plans are defined in Section 303.

3. If the site is more than 5 acres applicant must use TR-55 method to calculate pre-development vs. post-development comparison rates. If the site is less than 5 acres then the Rational Method may be used.

4. A preliminary water quality analysis will also be required for all sites to determine if the quality of the runoff from the site will be impaired from pre- to post-development of the site. The calculations for this analysis can be found in the Virginia Stormwater Management Handbook, latest edition. If the results show an increase in phosphorous loads from pre- to post-development a Stormwater Quality Plan will be required. Refer to Section 303 and 304 for more details.
Please Note: Applicants may choose to submit a letter asking for a waiver on this requirement on the basis that the development of their site does not significantly change the drainage pattern of the site and/or does not increase the runoff volume or runoff flow rates. Decisions on these waivers will be based on the City Engineer’s approval.

303 Final Stormwater Management Plan

303.a. Part 1 – Final Stormwater Quantity Plan

1. If the post-development runoff rate, volume, or velocity is greater than the pre-development runoff rate, volume, or velocity then the stormwater management facility(ies) should be designed such that the post-development runoff rate, volume, and velocity do not exceed the pre-development conditions.

2. All sites that are required to incorporate any stormwater facilities will be required to first analyze the use of water quality BMPs including low impact development (LID) design and Infiltration Practices. (Please refer to the City Stormwater Guidance Manual and Virginia Stormwater Management Handbook, latest edition for suggested measures).

3. Design Storm Frequency

   a. Use 2-year pre- and post-development peak rate of runoff for design of open channel velocities for erosion and for BMPs

   b. Use 10-year pre- and post-development peak rate of runoff for design capacities and velocities of piped systems and for BMPs

   c. Storm sewers shall have sufficient capacity to carry the calculated runoff from a 10-year frequency storm without surcharge

   d. Use 100-year pre- and post-development peak rate of runoff for design of detention facilities, bioretention facilities, and spillways to identify possible impacts to adjacent properties

4. Design Criteria

   The following engineering calculation methods may be used to design a stormwater management facility in the City of Charlottesville:
a. Rational method can be used for storm sewer design calculations. Standard VDOT LD-229, LD-347 forms (for storm sewer computations and hydraulic grade line computations) should be provided.

b. When detention and routing calculations are required for the proposed stormwater management facility, TR-55 method must be used for calculating the runoff and routing the hydrographs. Rational, modified rational and other methods are not acceptable.

303.b. Part 2 – Final Stormwater Quality Plan

1. Basis of Design for Water Quality

Phosphorus is used as the indicator nutrient in urban runoff in the City of Charlottesville and the Commonwealth of Virginia. For the purposes of water quality compliance with City stormwater goals, Phosphorus shall be used as the target pollutant. Virginia Stormwater Management Handbook, latest edition should be used for the guidelines on how to calculate phosphorus load for comparing pre-development conditions with the post-development conditions. The Virginia Stormwater Management Handbook, latest edition will also help to identify the best measures to use on the site based solely on the amount of reduction in phosphorus levels that are required. Use this information in collaboration with the capacity capability of each BMP structure to create the most appropriate SWM plan for your site. The goal is to prevent an increase in phosphorus from pre-development to post-development levels.

2. Must provide adequate BMP and LID features to meet the required efficiency and removal rates for the site as per the Virginia Stormwater Management Handbook, latest edition.

3. Please note that a water quality component/modification to an existing Stormwater Management facility may be required, due to increased phosphorous levels as determined in the preliminary drainage study, even if the post-development runoff rates do not exceed the pre-development runoff rates.

304 Other Design Clarifications

1. Designers often propose to use BMPs such as bioretention facilities for quantity control. Although such BMPs are primarily designed for water quality treatment, City recognizes the space constraints in previously developed sites and will allow the use of such BMPs for both quantity and quality control if the design adheres to good engineering practices that use the most stringent criteria of the typical detention facility and BMP.
If a bioretention facility is used for both water quantity and quality then the bioretention bed should be sized for minimum 5% of the impervious area draining to it, the outlet should discharge into an adequate channel, and provide adequate freeboard (1’ above 10-year water surface elevation) in addition to the minimum media requirements for water quality treatment. Routing calculations to prove adequate storage for detention will still be required.

2. Computer Modeling for Stormwater Calculations

City of Charlottesville participates in the FEMA National Flood Insurance Program. Localized urban flooding is common and City thus recommends using hydrologic and hydraulic computer models approved by FEMA for consistency. A list of the appropriate models for use is available at:

http://www.fema.gov/plan/prevent/fhm/en_hydro.shtm

For ease of choosing models from designer’s perspective, City prefers HEC-HMS, SWMM, Pondpack or similar models for hydrologic and hydraulic analyses from the FEMA list. HEC-RAS, FlowMaster or similar models are preferred for required channel adequacy calculations.

Please note that models developed and adopted by other localities are not industry standard and will not be accepted unless supported by detailed model description and criteria for selection depending on review and approval from the Office of the City Engineer.

305 Pipe Size and Materials

1. All storm drain pipes in the right-of-way or in connection with the construction of streets and sidewalks shall be constructed of RCP (reinforced concrete pipe) or HDPE (high density polyethylene). Pipe materials shall change only at junctions. The minimum pipe size for all types is 15-inches.

2. 5' minimum horizontal separation is required from edge to edge of storm pipes from all other utilities.

3. 18" minimum vertical separation is required for all storm pipes from sanitary sewer.

4. 12" minimum vertical separation is required between all storm pipes and waterlines.
5. Separation waivers/modifications may be allowed upon written request on a case by case basis. All waivers/modifications must be approved by City Engineer or approved designee.

6. Although not required, these practices are considered good engineering practice and are recommended for all storm pipes outside of the ROW as well.

306 References

The following references should be used to provide standard engineering calculations:

• Virginia Stormwater Management (SWM) Handbook (e.g., use for water quality worksheets, runoff calculations, BMP design)
• Virginia Erosion and Sediment Control Handbook (e.g., use for sediment trap design, sediment basin design)
• Virginia Department of Transportation Drainage Manual (e.g., use for storm sewer design)
CHAPTER 4 – EROSION AND SEDIMENT CONTROL

400 Intent and Purpose

The City of Charlottesville recognizes the need to protect water resources from non-point source stormwater runoff pollution. All regulated land-disturbing activities must comply with the minimum standards specified in Virginia Erosion and Sediment Control Law and Regulations, 4 VAC50-30-40 inclusive. This Chapter presents guidance for implementing the required E&S process.

401 Erosion and Sediment Control Plans

A. If a development/re-development site involves land disturbing activity (as defined by Chapter 10 of the Charlottesville City Code) of equal to or greater than 6,000 square feet, then an Erosion and Sediment Control Plan must be submitted and a Land Disturbance Permit must be obtained.

B. If any land disturbing activity less than 6,000 sf occurs, the site must adhere to the VA E&S Regulations to avoid any possible City Code violations. A handout is provided for these smaller lots on the City website www.Charlottesville.org under Neighborhood Development Services/Engineering, “Erosion and Sediment Control”.

C. Guidance for designing an E&S plan and narrative can be found in the Virginia Erosion and Sediment Control Handbook (latest edition) (VESC).

D. Specific E&S measures are required for Water and Sewer construction. See Appendix E & Appendix F.

E. The E&S process and steps for obtaining a Land Disturbance Permit is outlined in the City web site www.Charlottesville.org under Neighborhood Development Services/Engineering, “Erosion and Sediment Control”.

F. A detailed description of what is required in the Erosion and Sediment Control Plan submittal is also presented on the NDS/Engineering website in the form of a checklist titled “Engineering Plan Review Criteria”.

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CHAPTER 5 – TRAFFIC AND TRANSPORTATION

500 Intent and Purpose

It is our intent at the City of Charlottesville to encourage good planning, geometric design and operation of the City streets. This chapter describes the transportation planning and traffic analysis for development and redevelopment of streets to provide for safe, efficient and convenient movement of persons and goods. It identifies requirements for traffic control devices, including signs, pavement markings, signalization and lighting.

501 Projected Traffic

A. For the purposes of traffic analysis requirements, "projected traffic" includes the traffic resulting from the complete development of all land to be served by the subject roadway facility, including traffic forecast to be generated by development, both internal and external, to the project under consideration.

B. The basis for this forecast will be available information pertinent to the permitted land use and transportation planning for the proposed development and adjacent properties. The trip generation rates in the current version of Trip Generation, published by the Institute of Transportation Engineers (ITE) shall be utilized in determining the projection of traffic.

1. A Traffic Impact Analysis (TIA) will be required when the project will generate over 100 peak hour trips during any peak period. The City Traffic Engineer reserves the right to request a study if trip generation is over fifty (50) vehicles in any peak hour.

2. Trip generation data is required for all new development and redevelopment. Daily and peak hour trip generation data shall be included along with the Land Use Code used to determine the expected trips. Exceptions based on minimal impact may be approved by the City Traffic Engineer on a case by case basis.

502 Traffic Impact Analysis Report

A. Guidelines

The City of Charlottesville has the discretion to determine when a traffic impact study is needed. In general, if the site generates 100 total trips or more per hour during the adjacent street peak hour then a traffic study is required.
This section presents requirements for the submission of TIA’s to the staff of the City of Charlottesville’s Neighborhood Development Services. Unless otherwise agreed to, in writing by the preparer and City staff, failure to adhere to these requirements shall result in the rejection of the TIA. All deviations from the requirements listed below shall be attached to the TIA, referenced by chapter and section number (e.g. 2.B.). This attachment shall bear the signature of the preparer. All documents and deliverables shall be in printed and bound form, and at the option of City staff, electronic files of an agreed upon format, and shall be signed and sealed by a licensed Professional Engineer.

It is recommended that the Applicant meet with the City Traffic Engineer to determine the scope of the analysis prior to submitting the TIA.

B. TIA Requirements

1. Introduction

   The TIA shall include the following description and maps of the project:

   a. Description and Map(s) showing the site location, site topography, study area boundaries, and existing transportation facilities. Unless otherwise agreed upon in writing, transportation facilities external to the development shall be included if the project’s generated traffic will constitute at least fifteen percent (15%) of the facilities’ existing traffic volume. This area shall not extend more than five miles from the project site.

   b. Description and map or diagram of existing and proposed land uses/developments of the parcels in the study area in terms of various zoning categories.

2. Analysis of Existing Conditions

   Analysis of existing conditions shall include:

   a. Description and map or diagram of existing roadways, intersections, and other transportation facilities including road geometrics, lane usage, traffic control, and transit routes and stops within the study area.

   b. Traffic Volumes: Daily and peak hour traffic volumes, including turning movements, shall be collected on all transportation facilities within the study area boundaries. These traffic volumes shall be presented in diagrams and data included in the Appendix.
c. Capacity Analysis: Utilizing techniques as described in the most recent version of the Highway Capacity Manual, the relative balance between roadway volumes and capacity shall be assessed. Analyze existing conditions (roadway geometrics and traffic signal control) for all peak hours shall be analyzed. The results shall be displayed in a diagram and tables with levels of service and delay provided for each lane group.

1) All inputs to this traffic analysis software shall reflect observed conditions, including volumes, heavy vehicles, geometrics, and other system parameters. Peak hour factors used in the calculation of design hour volumes shall be calculated from observed volume data. Any assumptions made that deviate from the programmed defaults must be documented and an explanation provided as to why there was a change (i.e., lane utilization factor).

2) Levels of Service and Delay: Based on the results obtained in the analysis, the levels of service and delay for all intersections and intersection movements shall be presented. Include a description of typical operating conditions at each level of service. These levels of service shall be presented in diagrams and in tabular form.

3) Queuing Analysis: Based on the most recent version of the HCM or other acceptable engineering methods, determine the existing queue lengths at the study area intersections and whether sufficient storage exists shall be determined.

3. Analysis of Future Conditions without Development

An analysis describing projected future conditions assuming the project is not built shall include the following:

a. Analysis Year(s): The future year(s) for which projections are made will be specified by City staff and will be determined by the timing of the proposed development. In general, the analysis must include the "build out" year, when the development is expected to be completed. It should also include an analysis for each year in which significant phases are to be completed.

b. Future Traffic Volumes: There shall be a clear indication of the method and assumptions used to forecast future traffic volumes. The method and assumptions used shall be agreed upon by the preparer and City staff. These volumes shall be presented in diagrams.

c. Programmed Improvements: Description and map or diagram of proposed improvements to roadways, intersections, and other
transportation facilities including road geometrics, lane usage, traffic control, and transit routes and stops within the study area. Improvements should be considered in the traffic study if they are included in the Commonwealth of Virginia’s Transportation Development Plan or the relevant Secondary Six (6) Year Plan(s).

d. Future Capacity Analysis: The analysis must determine the ability of the existing roadway system to accommodate future traffic (without site development) for all peak hours based on the Highway Capacity Manual. If roadway improvements or modifications are committed for implementation, analysis of these conditions may be assumed.

1) Levels of Service and Delay: Based on the results of the capacity analysis, the levels of service and delay for all intersections and intersection movements shall be determined and presented in diagrams and tabular form.

2) Queuing Analysis: Using the same analysis method that was used for existing conditions, the future queue lengths at the study area intersections and whether sufficient storage exists shall be determined.

4. Trip Generation

The traffic to be generated by the site on both a daily and a peak hour (morning and evening) basis for the adjacent roadway system, plus the peak hour conditions for the site if different from above shall be presented. A table showing the land use amount (square feet, dwelling units, etc.), land use code, the trip rate or trip equation and the number of trips generated by the site must be provided. Trip generation rates to be used should be those presented in the current edition of the ITE Trip Generation. In multi-phase developments with multiple analysis years, the trip generation shall be consistent with the phased construction of the site. Any deviation from these rates must be justified and documented to the satisfaction of the City Traffic Engineer. For certain mixed-use developments, internal trip captures may reduce the amount of external trips. The methodology used to determine the internal capture must be documented, explained, and reviewed by the City Traffic Engineer.

5. Traffic Distribution and Assignment

The report must describe the direction of approach and departure for site-generated traffic and show on diagrams the traffic assignment to the road network serving the site for the appropriate time periods. The basic methodology and assumptions used must be clearly stated. The directional distribution should be based on anticipated employment,
commercial, and residential sites that will serve as the market or "draw" for the proposed development.

6. Analysis of Future Conditions With Development

An analysis describing projected future conditions assuming the project is built shall include the following:

a. Future Traffic Volumes: Future traffic volumes including both the background traffic and site traffic shall be clearly shown in diagrams for the study area.

b. Future Capacity Analysis: The analysis must determine the ability of the existing roadway system to accommodate future traffic (without site development) for all peak hours based on the Highway Capacity Manual. If roadway improvements or modifications are committed for implementation, analysis of these conditions may be assumed.

1) Levels of Service and Delay: Based on the results of the capacity analysis, determine the levels of service and delay. All intersections and intersection movements shall be presented in diagrams and tabular form.

2) Queuing Analysis: Using the same analysis method that was used for existing conditions, the future queue lengths at the study area intersections and whether sufficient storage exists shall be determined.

7. Recommended Improvements

The report must clearly describe and diagram the location, nature, and extent of proposed improvements to ensure sufficient roadway capacity and safe access to the site. Preliminary cost estimates, sources of funding, timing, and assurance of implementation shall be included.

Capacity Analysis: Describe the anticipated results of making these improvements.

a. Levels of Service and Delay: As a result of the revised capacity analyses including recommended roadway improvements, the levels of service and delay for the roadway system with improvements shall be presented in diagrams and tabular form.

b. Queuing Analysis: Using the same analysis method that was used for existing conditions, the future queue lengths at the study area intersections and whether sufficient storage exists shall be determined.
8. Conclusions

The last chapter of the report should be a clear, concise description of the study findings. This concluding chapter should serve as an executive summary.

503 Traffic Control Devices

A. Traffic Signals

1. General: This section provides direction for active traffic control devices. These devices include traffic signals, intersection caution beacons, emergency signals for fire stations, school zone caution lights, and warning beacons.


3. Design: Design criteria for traffic signalization will be established by the City Traffic Engineer for individual signalized intersections on a case by case basis.

B. Signs


2. Erection of signs shall be in accordance with the Virginia Department of Transportation Road and Bridge Specifications, Division VII.

3. All signs shall be shown on the Traffic Plan submitted by the applicant.

4. Street Name Signs

   a. Street name signs shall be large enough to be seen clearly from the roadway. The actual size of the street name sign shall be sufficient to display the street name.

   Minimum street name sign dimensions are 9 inches wide with sufficient length to display the street name. Maximum length shall be thirty-six (36) inches. The developer shall submit drawings showing proposed street name signs with dimensions and street name to the City Traffic Engineer. Approval of the City Traffic Engineer is required prior to fabricating the signs. Street name sign text shall be white letters 5
inches tall, roman font on a green background. Visibility of the sign and mounting shall meet requirements of the MUTCD.

b. Street name sign posts shall be 1 3/4-inch square, perforated welded steel tubing, fourteen (14) gauge, with 7/16 knockouts 1-inch on center, hot dipped galvanized Telespar Quick-Punch or equal.

5. Design of Signs: Regulatory, warning and directional signs shall meet the requirements of the current MUTCD, with the following exceptions:

a. W1-6: Arrow shall be twenty-four inches x twelve inches (24”x12”).

b. R7-1: No Parking Any Time shall be twelve inches by 18 inches (12”x18”).

c. R-1-1: Stop Sign shall be thirty inches x thirty inches (30”x30”).

d. Dead End Streets: Use OM4-3 without wording.

C. Pavement Markings

All pavement markings shall be shown on the Traffic Plan and shall conform to the MUTCD.

504 Lighting

A. Design of roadway lighting shall follow the requirements of the VDOT Traffic Engineering Design Manual, Section V Roadway Lighting. Illumination levels and impacts to adjacent properties shall conform to the City Code, Chapter 34, Zoning, Division 3 Outdoor Lighting.

B. Where ground-mounted lighting is required, to be turned over to the City for maintenance, details presented in Appendix A of this Manual will be used.

C. Dark-Sky preferred option: Dark-Sky Compliant Acorns: Bowery style, use www.ela-lighting.com or like kind. See picture below.

D. Standard Downtown Lighting Specifications

1. Luminaire: Durable corrosion resistant cast aluminum housing. Luminaries ET-1 and ET-3 supplied with up light components. Fixture shall be dark sky compliant.

2. Optics: Computer designed segmented reflector. Combines with clear tempered flat glass lens to produce a type III (asymmetric) light distribution.
3. Lamp Holder: Medium base porcelain.

4. Lamp: 100 W. M.H. (by others) horizontally mounted.


6. Arm: Durable corrosion resistant, cast aluminum construction.

7. Shaft: Fabricated from steel coil stock, (11 gage) shaft has 5.5" butt, tapering to four-inch (4.0") top minimum yield strength 55,000 P.S.I. shaft includes a 3"x5" hand hole furnished with cover. Shaft shall sustain a minimum of ninety (90) MPH wind gust.

8. Base Plate: Fabricated from structural quality hot rolled steel, base telescopes and is circumferentially welded to shaft.

9. Base Cover: Two (2) pieces, heavy wall construction entirely conceals anchor base.

10. Anchorage: (4) 1"x36" fully galvanized anchor bolts. Each bolt supplied with two nuts and two washers.


505 Traffic Plan

A Traffic Plan showing the proposed layout of signs, details, signals and pavement markings must be submitted to NDS for review by the City Traffic Engineer for all new development and redevelopment.
CHAPTER 6 – BRIDGES, RETAINING WALLS AND OTHER RELATED STRUCTURES

600 Intent and Purpose

The purpose for this chapter is to provide design criteria for structures in the right-of-way. The City of Charlottesville encourages the planning and design of structures to incorporate architectural treatment to provide an aesthetically pleasing appearance.

601 Bridge and Box Culvert Design Criteria

A. Loading

All bridges and culverts shall be of HS 20-44 loading or alternate military loading, or both, in accordance with the current AASHTO Bridge Design Specifications and VDOT modifications. To facilitate the City's review, all pertinent calculations for a structure's design shall be submitted with each bridge plan, box culvert plan or other nonstandard drainage structure.

B. Width

Clear roadway widths of all structures shall be in accordance with VDOT Road Design Manual.

602 Retaining Walls

A. General

All retaining walls greater than four (4) feet in height proposed for construction within the City of Charlottesville shall be engineered, designed, certified and sealed by a Professional Engineer licensed in the Commonwealth of Virginia. For the purposes of this section, the height shall be defined as the vertical dimension from the base of the toe/footing of the wall to the top of the wall. Designers are responsible for ensuring a safe and stable wall design. A geotechnical investigation shall be conducted in order to determine the soil properties and subsurface data necessary to design the retaining wall. Design calculations shall be prepared and submitted with the site plan for City review in accordance with this section and the current edition of the Virginia Uniform Statewide Building Code. All freestanding walls and walls extending from a building foundation wall that are four (4) feet or greater in height, whether or not attached or a continuous extension of a building foundation wall, will be submitted to the City for review. This requirement shall include engineered walls, pre-engineered manufactured wall systems, VDOT
Standard gravity retaining walls (RW-2 & RW-3), and mechanically reinforced earth systems.

For walls four (4) feet in height or less, the Developer may utilize a “pre-engineered” wall system, provided that the wall is constructed in accordance with the manufacturers’ or designers’ design guides, charts and/or graphs. Copies of the design information will be submitted to the City for review with the site plan. These wall systems include Modular Block and Segmental walls. In addition, the Developer may utilize VDOT standard gravity retaining walls (RW-2 or RW-3, as appropriate) for walls fifteen (15) feet in height or less. Submit appropriate documentation to indicate that the wall will be constructed in accordance with VDOT standards and within the appropriately tabulated design values.

The requirements of this section shall not apply to construction of minor wall structures associated with landscape improvements.

B. Requirements for Plans

All walls will be detailed on the plans, whether they are engineered, or not. Plans will include, as a minimum, the following information.

1. Notes & Specifications

Notes and specifications will include, at minimum, the following:

a. Soil bearing capacity, as indicated in the Geotechnical Report or the assumed value if a Geotechnical Report was not required. If the assumed bearing capacity exceeds the VUSBC minimum value of 2,000 psf, the notes shall indicate the basis for this assumption and indicate the proposed method to insure that the design assumption is appropriate during construction.

b. Soil properties used in design (e.g., unit weight, equivalent hydrostatic density of the retained soil mass, friction angle, cohesion, etc.). Identify whether or not these values are assumed (and the basis of the assumptions) or are based on geotechnical testing.

c. Wall materials and their design strengths.

2. Typical Sections

Will show and label the items described below.

a. Maximum slope and dimensions of backfill.

b. Assumed loading/surcharge on the retained soil mass.
c. Provisions for backfill and foundation drainage.
d. Size and location of keys or dowels, if required to resist sliding.
e. Location of horizontal construction joints and keys.
f. Method of attachment for wall facing, if provided (i.e., block ledge, masonry anchors, etc.).
g. Guardrails where adjacent vehicular traffic is expected. Guardrails shall be designed in accordance with the AASHTO requirements for HS-20 loading.
h. Handrails where adjacent pedestrian use is expected, in accordance with the requirements of the VUSBC.
i. Profile to show utility crossings, measures required to protect and/or maintain utilities or special features as necessary.

3. Plans and Elevations

Will show and indicate, as a minimum, the following:

a. A plan view of the entire wall, providing all information necessary (offsets, tie-ins, curve/turn data, etc.) to establish vertical control for construction of the wall.
b. An elevation view of the wall, providing all information necessary (top of wall elevations, footing elevations, vertical offsets, etc.) to establish vertical control for construction of the wall.
c. Location of expansion joints.
d. Location of vertical construction joints.
e. Details of the wall face finish.

C. Structural Calculations

Structural calculations will be complete and will include, at a minimum, the following:

1. All material and backfill properties utilized in the design, to match those indicated on the plans.
2. Surcharge and lateral loads (pedestrian, vehicular) referencing appropriate VUSBC or VDOT standards, or adequately explained.
3. Maximum bearing pressure.
5. Working and allowable stresses or actual and factored ultimate strengths.
6. A written summary that clearly describes the assumptions, methods, and conclusions.

D. Wall Aesthetics
It is the City’s intent that all wall proposed for construction in the City of Charlottesville shall include aesthetic considerations, and shall be finished in such a manner so as to be compatible with the surrounding environment. In the event that a concrete wall is utilized, the finished, exposed surfaces shall be constructed utilizing a form liner system as a minimum.

Form liner finish shall replicate brick, stone veneer or random board finish and the concrete shall be tinted or painted as required to provide a finished surface in keeping with the pattern of the finished face. Alternatively, a brick, ashlar stone or field stone finish may be used. See Figures 6-1 through 6-6 at the end of this Section for suggested wall finishes. Modular or segmental wall systems shall utilize finished faces of an appropriate finish, preferably a split face block finish, and color to complement the adjacent environment. The exposed face of all walls shall be battered a minimum of one-fourth inch (¼"") per foot of height of wall toward the retained soil mass. The City shall review and approve the proposed wall finish prior to the construction of any retaining wall in the City.

E. Foundation Drains

Foundation drains, weep holes, or other means of releasing hydrostatic pressure shall be provided for all retaining walls.

F. Geotechnical Investigations

All designed walls shall be design based upon a geotechnical engineer. A copy of the Report of Findings of the Geotechnical Investigation shall be submitted with the wall design calculations. Geotechnical investigations are highly recommended for walls not designed by an Engineer to insure adequate information regarding assumed design criteria utilized in applying manufacturers’ or designers’ design guides, charts or graphs.

G. Notification of Changes

Developer shall notify the City and obtain approval for any changes in the wall design, specifications, wall manufacturer (in the case of a pre-engineered wall product), location, or changes in site conditions that alter the design values or assumptions prior to the construction of the wall. At minimum the Developer will provide the City with a written explanation of the changes. When deemed necessary by the City to protect public health, safety and welfare, some changes may require the submittal of supplemental detailed information, revised plans, and/or computations for review and approval prior to construction of the wall(s).
Figure 6-1
Colonial Dry Stack Pattern

Figure 6-2
Weathered Ashlar Pattern
Figure 6-3
Random Field Stone Pattern

Figure 6-4
Country Stone Pattern
Figure 6-5  
Random Board Pattern

Figure 6-6  
Brick Pattern
CHAPTER 7 – POTABLE WATER AND SANITARY SEWER MAINS AND RELATED FACILITIES

700 Intent and Purpose

The purpose of this section is to provide the minimum requirements, recommended criteria/practices, and procedural guidelines for the planning, design, submission, construction, testing, and approval of constructed public, central, and individual water and wastewater systems. Full documentation of the Potable Water and Sanitary Sewer Specifications can be found in Appendix E and Appendix F, respectively.

701 Potable Water and Sewer Systems


702 Engineering and Architectural General Conditions for Potable Water and Sanitary Sewer System Design

A. General

1. The design of all potable water system and sanitary sewer systems shall be performed under the direction of a registered professional engineer with a current registration in the Commonwealth of Virginia in accordance with Title 54.1, Chapter 3 of the Code of Virginia, 1950, as amended. Where applicable and in accordance with DPOR Regulations, design may be performed under the direction of a certified land surveyor in accordance with Section 54.1-408 of the above-cited Code.

2. The design of all potable water systems shall conform to the Virginia Department of Health Waterworks Regulations and to the requirements of other state and federal agencies having jurisdiction. The design of all sanitary sewer systems shall conform to the Virginia Department of Environmental Quality Sewage Collection and Treatment Regulations and to the requirements of other state and federal agencies having jurisdiction.

3. All designs shall conform to the requirements of the City of Charlottesville. Where the requirements of the state and city are in conflict, the more restrictive requirements shall govern.
4. The designer shall be responsible for obtaining the review and necessary approvals of all drawings and specifications by applicable agencies having jurisdiction. Copies of such approvals shall be submitted to the City prior to final review.

5. Water lines for developments or subdivisions are to be designed for maximum build-out of the area of which the subdivision or development is a part. Sanitary sewer lines for development or subdivisions are to be designed to serve the entire watershed of which the subdivision or development is a part. This necessitates consideration of property beyond the development or subdivision in question. The designer is required to design and construct the system, properly sized at an appropriate location, to permit future extensions to be made at the limits of the subdivision or development in question. Elevation of the proposed sewer system lines and structures must be designed such that future extensions can serve the entire area that naturally drains towards the existing system.

B. Engineering Report

1. An engineering report shall be submitted to and approved by the City before approval of drawings and specifications. The engineering report shall include a preliminary system design and an overall system layout plan. The report shall demonstrate that the water lines and sanitary sewer lines are designed to serve the entire subdivision or development. Where phase development is contemplated, the extent of each phase shall be clearly delineated.

   a. Capacity studies for water lines will be required on an as-needed basis as deemed necessary by the Director of Public Utilities for developments exceeding 40,000 gallons per day average flow based on VDH Water Works Regulations.

   b. Capacity Study Requirements for Sanitary Sewer.

   Estimate of flow rate of sewage from a development:

   The estimated flow rate shall be based on Table 3 in VDH Sewage collection and Treatment Regulations (SCAT) 9VAC25-790-460. These figures may need to be adjusted to include infiltration and inflow.

   Additional provisions for inflow, infiltration and appropriate peaking factors shall be provided by the City of Charlottesville in consultation with the designer.

   The basis of design shall, in general, be that the sewer systems be designed for the estimated ultimate tributary population with an upper limit consisting of the 50-year population growth projection. Consideration shall be given to land use plans and to other planning documents and to the maximum anticipated capacity of institutions,
industrial parks, apartment developments, etc. as required by SCAT Regulations 9VAC 25-790-310.B.

The minimum peak design capacity for lateral and submain sewers should be 400% of the average design flow SCAT Regulations 9VAC 25-790-310.D. This includes the effect of infiltration.

The minimum peak design capacity of main and trunk sewers should be 250% of the average design flow and minimum peak design for interceptor sewers shall be 200% of the average design flow SCAT Regulations 9VAC 25-790-310.D. This includes the effect of infiltration.

Guidance for determining sewer system adequacy:

Sewage collection system downstream of the development shall be evaluated on an as-need basis as deemed necessary by the Director of Public Utilities. In general, developments generating 4,000 gallons per day (average daily flow) or more sewage shall comply with the following. The designer shall:

- Provide sewage quantity estimates from the development
- Provide capacity of receiving line at tie-in point and downstream at any critical points (as determined in consultation with the City) to where the line connects with a trunk line as defined in Appendix F.
- Provide a plan indicating the sanitary sewershed that the proposed development will impact. Label manholes with the city manhole ID numbers. Indicate MH top elevations, invert elevations, slope of line, and diameter of pipes. Include this information in a table as well, and
- Provide a table indicating the proposed additional load on the sewage collection system, the current capacity of the downstream lines analyzed, and a determination if there is available capacity to handle the proposed additional load.
- Evaluation of capacity of the existing system shall include flow monitoring at a minimum of one location and may include additional locations as determined by the City of Charlottesville after consultation with the designer. Flow monitoring device(s) shall be in place so as to obtain thirty (30) days flow data. The City requires analysis to a point where the sanitary sewer becomes a trunk line (i.e. is a continuous twelve (12)-inch diameter or greater).

Sharing of data:

All data submitted to the City shall be made available to any and all interested parties.
2. Preliminary System Design
   a. An analysis shall be prepared that tabulates the number of people being served or proposed to be served. The tabulation shall be by incremental areas for evaluation purposes.
   b. Average and maximum flows shall be developed for areas and sub-areas and tabulated in the report as deemed necessary or appropriate.
   c. The design documentation shall address total current and projected future flows and system capacities of existing and proposed utilities and shall provide the proposed line sizes.
   d. Facility sizing shall be based on ultimate development (complete build-out of the area) and shall present all information necessary for a sound evaluation of the factors used in development of the report.
   e. If proposed, an alternate design incorporating interim or stated construction shall be included.

3. The system layout plan shall delineate service area boundaries and clearly define the areas pertinent to interim and ultimate development of the service area. The system layout plan shall show present and future development, proposed interim and future utilities, and existing utilities that will be affected by or have an effect on the proposed utilities. Existing and proposed ground elevations shall be shown at contour intervals not exceeding five (5) feet unless otherwise approved by the City. Proposed utilities necessary to serve adjacent properties and associated easements shall be shown.

C. Contacting property owners: Prior to performing any survey and design work on private property, the engineer/surveyor shall notify the affected landowner of the proposed project. Notification shall be made in the form of a letter to be sent to the property owner seven (7) to ten (10) days before commencing work. Copies of such letter shall be provided to the City along with the initial plan submittal.

D. City Review of Construction Drawings
   1. Prior to construction of potable water facilities, construction drawings for the proposed facilities must be submitted for review to the City. The construction drawings must be in a form acceptable to the City. Ten (10) copies shall be submitted for review.
   2. Easements
      a. Off-site easements shall be recorded and the deed book and page numbers of the recordation included on the utilities plans before receiving approval of the plans for construction.
      b. Easements shall be required except where installed within a public right-of-way of the City of Charlottesville or Virginia Department of Transportation. If the utility is placed within the outer ten (10) feet of
the VDOT right-of-way, additional private easements shall be provided to allow ten (10) feet from the center of the pipeline. Easements shall not be less than twenty (20) feet in width centered on the main. Combined sewer and water easements shall not be less than thirty (30) feet in width with both mains ten (10) feet from the edges of the easement. The City reserves the right to require additional easement width if construction and maintenance activities require it (i.e. depth).

All easements shall have the right of ingress and egress fully provided for in the recorded deed. Where deemed necessary, easements shall extend to adjacent property for orderly extensions of service. No trees, shrubs, structures, fences, or obstacles shall be placed within an easement that would render the easement inaccessible by equipment. Any person who constructs a structure within the utility easement shall be liable for the cost of removal and any damage to the pipeline.

703 Construction Drawing Organization and Format for Potable Water and Sanitary Sewer Systems

A. Drawing Organization

1. Drawings shall consist of the following types of sheets arranged in the order listed.
   a. Cover sheet
   b. Index sheet (if necessary)
   c. Plan and profile sheets
   d. Standard sheets and special details
   e. Erosion and sediment control details

B. Sheet Format

1. All construction drawings shall be on sheets twenty-four (24) inches by thirty-six (36) inches.

2. The cover sheet shall contain the City’s name and project description in large, distinctive letters, a vicinity map drawn on a scale of 1 inch = 2000 feet to indicate the general vicinity of the contemplated construction, an index to the plan sheets, and a signed stamp of the design engineer or person responsible for the design. The vicinity map shall include a North arrow and a scale.

3. A plan index map shall be prepared for all pipeline projects. The index map shall be to a scale of not less than 1 inch = 600 feet, and shall show all proposed utilities with tie-ins to existing utilities. The lines of the proposed construction, together with proposed utility structures, shall be indexed to the drawings to indicate the extent of coverage on each drawing.
4. Plan sheets, as well as plan and profile sheets, shall show horizontal, vertical, and topographical data.

5. All plans shall bear a suitable title showing the City’s name and project title. The plans shall also show the scale in feet, the North arrow, the date, and the name of licensed professional responsible for preparation of the plans. Each plan sheet shall bear the same general title identifying the overall project, and shall be numbered.

C. Drafting Conventions

1. Industry standard symbols should be used for drawings where applicable. When standard symbols are not used, a symbol key shall be included in the drawing set. Existing facilities shall be differentiated from new facilities.

2. Standard symbols — proposed facilities: Symbols shall be as noted above except that solid lines shall be used for pipes, line weight shall be no lighter than 0.024 inches and no heavier than 0.031 inches.

3. Text, dimensions and notes: Lettering shall be consistent and clear with a minimum height of 0.125 inches (1/8 inch). The larger size lettering type shall have proportionately wider line widths. When drawings are prepared using computer-aided drafting (CAD), the minimum text height shall be 0.10 inches.

D. Drawing Standards

1. All plans shall comply with the format and quality control requirements of the City. Plans that do not meet these criteria will not be acceptable for review.

2. Plans submitted for review shall be direct blue line or black line prints. Photocopies or facsimile reproductions will only be accepted for information or preliminary review purposes.

3. Drawings shall be clear and legible. Text shall be readable when drawings are reduced to half size.

4. The contrast of the printed material shall be high, with blank areas being as white as possible, and all information being as dark as practicable, while remaining clear and distinct.

5. Shading, such as on plan views for paving, shall not be used on the drawings where it will hide any information when the drawing is photocopied or scanned. For areas that need to be identified or highlighted, stippling or cross-hatching may be used, provided no other information is hidden.

E. Additional Information

1. Horizontal scale in plan and profile sheets shall be no smaller than 1 inch = 50 feet.

2. Vertical profile scale shall be no smaller than 1 inch = 10 feet.
3. A bar scale shall be included on each sheet.

4. All known existing structures and utilities, both above and below ground, which might interfere with the proposed construction, particularly water mains, sewer mains, gas mains, storm drains, utility service lines, etc., shall be shown in plan and profile. Approximate locations shall be noted as such.

5. Benchmarks shall be set no more than 500 feet apart along the lines of construction but outside the limits of construction. Datum for elevations shown shall be USGS (United States Geographic System) Mean Sea Level.

6. Drawings shall show off-site easements required and identify deed book and page number.

7. Drawings shall show all property lines bordering the proposed work area. Property owners and tax map parcels shall be identified.

8. Project specifications shall be in the Construction Specifications Institute (CSI) 16-Division format. Specification sections contained herein shall be incorporated into the project specifications.

9. All sub-surface investigations, including test bores, reports, etc., utilized in the design shall be incorporated into the project specifications.

10. “As built” drawings shall be prepared and delivered to the City of Charlottesville by the designer, based on information provided by the Contractor, if so required in the contractual agreement between City and designer.

704 Contractor General Conditions

General Conditions of the Contract, entitled, __________, published by______and as amended by Supplemental Conditions shall be made a part of the Contract documents and shall apply to all Contractors and Subcontractors.

All Contractors and Subcontractors will be held to have examined and made themselves familiar with the articles of the General Conditions and the modifications and Supplemental Conditions thereof.

Unless otherwise indicated, in cases where a water service lateral or sewer service lateral is permanently taken out of service or abandoned (aka demolished) such as in the case of the demolition of a building, the contractor is responsible for removing the service line to the main. In the case of a water service abandonment, the contractor shall remove all service lines to the corporation stop and shut off the corporation stop. In the case of a sanitary sewer service abandonment, the contractor shall remove all service lines to the main and plug the tap and/or repair the main to the satisfaction of the City of Charlottesville. The contractor is responsible for any and all permits required to perform the work and repairing the paved surfaces as per these standards.
CHAPTER 8 – TRAFFIC SIGNALS

800 Intent and Purpose

This work shall consist of furnishing and installing traffic signal equipment in accordance with these specifications and as shown on the plans or as directed by the Traffic Engineer. The terminology used herein and on the plans shall be as generically interpreted by manufacturers in the field except that certain terminology shall be interpreted as follows:

- Auxiliary equipment: separate devices used to add supplementary features to a controller, such as conflict monitors, load switches, and flashers.
- Manufacturer: the company that assumes the responsibility for producing and assembling the equipment and that is responsible for guarantees and warranties for the equipment.
- System: the coordination of traffic signals through a time relationship or by interconnection of controllers with a master controller or computer to permit coordinated movement along a street(s).
- System manufacturer: the company or system supplier that assumes the responsibility for procuring and assembling the equipment and that is responsible for guarantees and warranties for the equipment.

801 Equipment

Traffic signal controllers, master controllers, auxiliary equipment, and flashers for operating flashing beacons furnished by the Contractor shall be certified by the manufacturer as conforming to the requirements of 170 and any exceptions and additions stated herein unless otherwise specified. The manufacturer shall also provide certification from an independent testing laboratory that the model of controller, auxiliary equipment, and flasher furnished conforms to 170 environmental standards and test procedures. Controllers and auxiliary equipment shall be the manufacturer’s standard design. Controllers shall be furnished completely housed in a weatherproof cabinet. Controllers and auxiliary equipment shall operate from a 120-volt, 60-Hz, single-phase, AC power supply. The manufacturer’s name, model number, serial number, and part identification number shall be permanently attached to the cover of the equipment. The Contractor shall furnish the manufacturer’s instructions for installing and maintaining the equipment.

A. Traffic signal controllers shall be 170E, HC11 and shall provide all features and functions as existing controllers in the City’s systems and shall completely interface with the system masters and the office computer system software. When the controllers are being installed in an isolated situation, or in a system situation utilizing spread-spectrum radio interconnect, the controllers shall contain an additional serial device. When the controllers are
being installed in a system situation utilizing hardwire interconnect, the controllers shall be capable of supporting full communications with the master controller.

B. Flashers for Operating Flashing Beacons shall be solid state, double circuit, and shall be furnished complete in a weatherproof cabinet. The cabinet shall be fabricated of welded sheet aluminum at least 0.125 inch in thickness. The cabinet shall have transient protection conforming to the requirements of D.4.f. herein for field wiring, a door gasket, and a standard police panel lock with two keys. A radio frequency interference filter rated at 20 amps, terminal block, and a 20-amp circuit breaker shall be mounted in the cabinet. The cabinet shall be provided with removable hub plates tapped for 1-inch conduit at the top and bottom and shall be equipped with brackets for wood-pole mounting or with adjustable bands for steel-pole mounting as specified on the plans.

C. Master controllers shall provide all features and functions as existing master controllers in the City’s systems and shall completely interface with the local controllers and the central office computer software.

D. Cabinets: Cabinets for traffic signal controllers and master controllers shall be 4 door Model #333. Cabinets shall be weatherproof and constructed of welded sheet aluminum, 0.125-inch minimum. Cabinet mounting attachments shall be durable, corrosion resistant, and of heavy-duty construction.

Cabinets shall be at least 62 inches in height (54 inches + 8 inch base adapter), 44 inches in width, and 26 inches in depth and shall be large enough to provide for ease of maintenance of the controller and auxiliary equipment. The maximum width and depth shall be such that the cabinet will fit entirely on the standard CF-1 foundation per VDOT’s Road and Bridge Standards. The cabinet bolt pattern shall be rectangular, with dimensions of 40 5/8 inches in width and 18 1/2 inches in depth. Anchor bolts shall be 3/4 inch in diameter and at least 16 inches in length with a 5-inch L bend.

1. Doors: Cabinet doors shall be consistent with 4 door Model #333 and provide full access to the cabinet interior and shall have gaskets to ensure weatherproofing. A small recessed police panel with a separate access door shall be provided in the front door of the cabinet. The main door shall be equipped with the City’s standard Corbin lock No. 2 or the and shall be keyed. The police panel shall be provided with a standard police panel lock. Two keys for each lock shall be provided to the Traffic Engineer. Hinges shall be stainless steel and continuous. The main door shall have a door stop arrangement that will allow it to be firmly positioned at both 90 and 135 degrees, +/- 10 degrees. The locking mechanism for cabinets shall be a three-point draw roller system. Rollers shall be fabricated from nylon with a diameter of at least 8/10 inch. The door opening shall be double flanged on all four sides.
2. Police Panel: The police panel shall be furnished with three toggle switches, each labeled for its purpose. One switch will be used to place the signal in flashing operation and shall not affect the power being supplied to the controller and the conflict monitor. Upon placement of the switch from the automatic position to the flash position, the intersection shall immediately be placed in flashing operation and stop timing shall be applied to the controller. Upon placement of the switch from the flash position to the automatic position, the signals shall immediately be placed in automatic operation in the major street through phase green interval and stop timing to the controller shall be canceled. The second switch shall be used to allow manual operation of the controller phasing. The third switch shall be a standard on/off switch. All toggle switches shall be installed so the normal mode of operation is when the switches are in their "up" position.

3. Interior: The interior of cabinets shall be of sufficient size to provide adequate ventilation of the equipment housed therein. Cabinets shall contain at least three shelves or equivalent supports with enough space to hold the required auxiliary equipment. Cabinets shall have a full extension sliding drawer with flip up cover attached to the middle shelf suitable for document storage and as a station for a laptop computer. Vertical mounting channels for the shelves shall be continuous and shall allow for adjustable shelf placement ranging 5 inches from the bottom to 5 inches from the top of the cabinet. Con ductors connected to terminals located on the door shall be bundled and sheathed. The bundled conductors shall not obstruct access to other circuits and terminals in the cabinet. The controller equipment and terminals shall be arranged within the cabinet so that they will not interfere with the entrance, tracing, and connection of conductors. Unless a cable is passing through the cabinet uninterrupted, incoming and outgoing conductors shall have each wire connected to terminal post positions.

Cabinets shall be in accordance with 170 Type 333 as applicable. The cabinet shall also be wired to produce controller pin connector functions, including those on auxiliary connectors.

The Contractor shall install two copies of the circuit diagram inside the cabinet in a readily accessible waterproof enclosure and shall furnish three additional copies to the Traffic Engineer. The waterproof enclosure shall be securely attached to the cabinet with studs welded to the cabinet and nuts. The enclosure shall have noncorrosive metal grommets for use with the studs.

A listing indicating terminal numbers with a description of their use shall be attached to the cabinet door and overlaid with a clear, plastic covering. Edges of the plastic shall be sealed with a clear waterproofing compound.
Detector harness cables shall be stranded copper and shall be not sized less than No. 22 AWG rated at 300 volts. Other AC and DC circuit wiring shall be in accordance with 170 Type 333 as applicable. Ribbon cable and printed circuit boards will not be allowed for cabinet wiring. These wires in the detector harnesses shall be permanently identified with a nylon tag attached to the wires. Identifications on the tag shall indicate the phase, and shall be legible and accomplished with permanent ink.

Outgoing traffic signal circuits shall be the same polarity as the line side of the power supply. The common return of signal circuits shall be the same polarity as the ground side of the power supply. The power supply shall be grounded to the ground bus of the controller cabinet. The ground bus, neutral bus, and logic ground bus in the cabinet shall be copper.

Transient protection shall be provided in traffic signal controller and master controller cabinets for the following:

a. Main AC Power input: Transient protection for the AC power input shall be connected on the load side of the main AC circuit breaker. Transient protection shall consist of a modular package with a base and socket and matching plug–in transient device. The transient protector shall include LEDs for failure indication, and remote sensing output circuitry designed for modem/computer polling remotely. The transient protection shall (1) withstand a 20,000-ampere surge current with an 8x20 microsecond wave form, 20 times at 3 minute intervals between surges without damage to the suppressor; (2) limit the surge voltage to a 2,000-volt peak; and (3) limit follow current to an appropriate level to prevent tripping of the main circuit breaker of the cabinet or enclosure.

b. Interconnect cable and field wiring: Transient suppression for field wiring shall be installed on the front of the back panel. Transient suppression for interconnect cable and field wiring, except loop detector lead-in cable, shall (1) clamp the surge voltage to a level no greater than twice the peak operating voltage of the circuit being protected and (2) withstand a surge current of 1,000 amperes with an 8 by 20-microsecond wave form, six times at 1-second intervals between surges, without damage to the suppressor.

4. Accessory and auxiliary equipment: As a minimum, traffic signal controller cabinets shall be furnished with the following:
   a. Ground fault convenience receptacle.
   b. Screened and louvered vent designed to prevent rain entry, with a vent filter. The filter tray shall be sized to house and secure the filter in place. The screen shall be constructed from at least 0.031-inch aluminum with 1/8-inch diameter openings positioned on 3/16-inch
staggered centers. The screen shall be placed on the inlet side of the filter and held in place by the filter or silicone adhesive.

c. Screened air exhaust opening under the top overhang.
d. Two thermostatically controlled vent fans with a screen guard in the top section of the cabinet with a capability of exhausting at least 100 CFM per fan. The thermostat shall be adjustable from 80 degrees F to 130 F. Degree markings shall be indicated on the thermostat in 10-degree increments. One thermostat shall control both fans.

e. Radio frequency interference filter rated at 50 amps.

f. Transient protection devices.

g. Dual-circuit flasher, 15 amp rating over the temperature range of -34 degrees C to +74 degrees C conforming to 170 standards with an LED indicator for each circuit.

h. Fluorescent lamp, ordering code #F20T12/D, and an on/off door switch located in the cabinet so that it will provide for the unobstructed illumination of controller timing adjustments. A toggle switch mounted on the cover behind the police panel, and a momentary switch operated by the door shall be connected in-line for operation of the lamp.

i. Sixteen-channel 170 Model 2010 rack mounted conflict monitor.

j. Detector Racks: Cabinets shall include vehicle detector racks. The configuration for each rack shall be as follows:
   - Sixteen channels of 170 type detection (eight, 2 channel detector cards). The detector rack shall be provided with the two slots wired for four channel 3M opticom emergency pre-emption cards.
   - The detector racks shall as a minimum meet the requirements of all applicable 170 standards. The detector frame shall be constructed of aluminum. The frame material shall be of sufficient thickness to prevent bending or flexing when detector or other cards are being inserted or removed.
   - The circuit reference designation for all components and the polarity of all capacitors and diodes shall be clearly marked adjacent to the component. Pin 1 for all integrated circuit packages shall be designated on both sides of all printed circuit boards. All electrical mating surfaces shall be gold-plated for the BIU(s) and detector(s). The detector rack inputs and outputs shall interface with cabinet wiring and terminals through a series of paired connectors. One side of the connector shall be mounted on the detector rack and the other side shall be connected on the interface cable. It shall be possible to isolate the detector rack from the cabinet wiring by disconnecting the connections. It shall not be necessary to remove any wires from terminals or to cut any wires to isolate the rack wiring from the cabinet wiring.

k. Grounding: The grounding system in the cabinet shall be divided into three separate circuits, AC Neutral, Earth Ground, and Logic Ground.
E. Signal Heads: Signal head sections used in installing intersection control beacons and hazard identification beacons shall be the same as those described herein for standard traffic signal head sections. Cast aluminum signal head sections shall be used.

1. Traffic signal lamps shall be LED only.

2. Four section signal heads shall be used rather than five section heads. The bottom section shall be a green/amber combination arrow.

3. Traffic signal back plates shall be specifically manufactured for the type and brand of signal heads used to ensure proper fit with a border width of 5 inches and shall be without louvers and of one-piece construction.

4. Standard traffic signal head sections shall conform to the requirements of the ITE Standard for Vehicle Traffic Control Signal Heads and Section 238 of VDOT's Road and Bridge Specifications. Cap visors shall be included on all sections except head assemblies used only to control separate left and right turn lanes which shall include tunnel visors on all sections.

5. Selective view traffic signal head sections shall conform to the requirements of Section 238 of VDOT's Road and Bridge Specifications, shall permit the visibility zone of the indication to be determined optically, and shall not require hoods or louvers. The projected indication shall be selectively visible or veiled within 15 degrees of the optical axis. No indication shall result from external illumination, and one light unit shall not illuminate another unit.

6. The optical system and materials shall be composed of a lamp with a collar, an optical limiter-diffuser, and an objective lens. The lamp shall be a three-pronged LED having an integral reflector with stippled cover and shall be coupled to the diffusing element with a collar that includes a specula inner surface. The diffusing element shall be discrete or integral with the convex surface of the optical limiter.

The optical limiter shall provide an accessible imaging surface at focus on the optical axis for objects 900 feet to 1,200 feet away and shall permit an effective veiling mast to be variously applied as determined by the desired visibility zone. The optical limiter shall be provided with a means for positive indexing and shall be composed of heat-resistant glass.

The objective lens shall be a high-resolution annular incremental lens hermetically sealed within a flat laminate of weather-resistant acrylic or an approved equal. The lens shall be symmetrical in outline and capable of being rotated to any 90-degree orientation about the optical axis without displacing the primary image.
The optical system shall accommodate the projection of diverse, selected indications to separate portions of the roadway such that only one indication will be simultaneously apparent to any viewer. The projected indication shall conform to ITE transmittance and chromaticity standards.

The signal case and lens holders shall be predrilled for back plates and visors. Hinge and latch pins shall be stainless steel. Access openings shall be sealed with weather-resistant rubber gaskets.

The signal shall mount to a standard 1 1/2-inch traffic signal fitting as a single section, a multiple section face, or in combination with other signals. The signal section shall be provided with an adjustable connection that permits incremental tilting from 0 to 10 degrees above or below the horizontal plane while maintaining a common vertical axis through the couplers and mounting. The terminal connection shall permit external adjustment about the mounting axis in 5-degree increments. The signal shall be mountable with ordinary tools and capable of being serviced with no tools.

Attachments, such as visors, back plates, and adapters, shall conform and readily fasten to existing mounting surfaces without affecting the water and light integrity of the signal.

Each signal section shall include a covered terminal block for clip or screw attachment of lead wires. Concealed No. 18 AWG stranded and coded wires shall interconnect sections to permit field connection within any section.

The signal head shall be optically programmed in accordance with the manufacturer’s recommendations.

7. Pedestrian signal heads shall conform to the requirements of ITE Standards for Pedestrian Traffic Control Signal Indications and Section 238 of VDOT’s Road and Bridge Specifications.

8. Lane-use control signal heads shall conform to the requirements of ITE Standards for Lane-Use Traffic Control Signal Heads and Section 238 VDOT’s Road and Bridge Specifications.

F. Illuminated Traffic Control Signs: Signs shall be square or rectangular weatherproof units. Only internal illumination shall be used. When illuminated, the message shall be white on an opaque background. The sign face or cover shall consist of a polycarbonate lens. The housing shall be sheet aluminum at least 0.125 inch in thickness finished with two coats of flat black paint.

The size and arrangement of letters forming the message shall conform to the requirements of the manual on Uniform Traffic Control Devices or an
adaptation approved by the Traffic Engineer. When activated, the message shall be clearly readable at all times at a distance of 200 feet in all atmospheric conditions except dense fog. The message shall be controlled by a time clock or another type of actuation as specified on the plans. Signs shall illuminate instantly without a “warm-up” requirement or continuously energized ballast. When signs are deenergized, the message shall not be readable.

G. Detectors:
1. Inductive loop detectors shall conform to the requirements of the performance characteristics required by 170 and shall be rack mounted.

The manufacturer of the loop detector amplifier shall provide a certification from an independent testing laboratory that the model furnished complies with 170 Environmental Standards and Test Procedures.

Loop detector amplifiers shall be a dual-channel, rack-mounted, relay-output type with indicator lights on the front panel and delay and extension detection features. When the delay feature is used, it shall be inhibited during the green interval of its associated phase. The detector amplifier shall be adequately fused, and fuses shall be easily replaceable from the front panel.

2. Video detection shall be “Trafficon” only. Video detection shall detect by processing video images and providing detection input for 170 traffic signal controllers. Video detection equipment shall be the manufacturer’s standard production model. Video detection equipment shall have been in successful operation for a period of at least one year at twelve signalized intersections. The Contractor shall provide the contact person, location, date of installation, and equipment installed to the Traffic Engineer upon request for verification.

a. Environmental Camera Enclosure Housings shall be constructed of 6061-T6 aluminum and finished with a weatherproof, heat-reflecting paint. The environmental enclosure shall have a maximum outside diameter (O.D.) of 5 inches, excluding mounting assembly.

Each enclosure shall be sized to accommodate lens adapters (if necessary). The front of the enclosure shall extend beyond the viewing window or have provisions to do such so as to act as a sun visor and to prevent water runoff into the camera lens.

Sunshields shall be supplied and installed on each camera to protect the camera from direct sunlight. The Contractor shall submit details of the camera housing to the Traffic Engineer for review and approval prior to ordering housing units.
The housing shall be equipped with a heater, a window defroster, and a thermostat to control both.

The camera enclosure shall be provided with separate, weather-tight connections for video and power cables at the rear of the enclosure. Connectors shall not allow moisture entry.

b. Cameras shall be monochrome high or medium resolution. Line lock shall be provided and no interlace jitter or pairing on the viewing monitor shall be discernible. The system shall provide clear, low-bloom and low-light video images at all times, including limited illumination during nighttime hours and during inclement weather.

The camera shall be of solid-state design and conform to the following minimum requirements:

- Image Sensor - The image sensor shall be 1/3 inch charge-coupled device (CCD) or an approved equivalent.
- Sensitivity - A useable picture shall be provided with a minimum scene illumination of 0.1 lux with AGC on.
- Resolution - 500 line horizontal and 350 lines vertical minimum.
- Video Signal Output - Shall conform to EIA RS-170 standard.
- Output Impedance - 75 ohms ± 5 percent.
- Operating Voltage - 125 VAC, 60 Hz.
- Automatic Gain Control (AGC) - The switch selectable fixed gain response shall maintain the output level to 90 percent video when the light level on the image sensor falls too low to maintain full video output. The camera shall have an adjustment for the AGC to optimize video output under varying conditions.
- Meantime Before Failure - Meantime before failure shall be a minimum of 20,000 hours.
- Operating Temperature - -34 to +50 degrees C at an outdoor ambient humidity of up to 95 percent, non-condensing.

c. Camera Lens shall be a variable focal length lens capable of covering the intersection detection zones indicated by the plans. Motorized auto-iris control and neutral density spot filter shall be provided with each lens. The lens mount shall be standard and compatible with the camera. The iris shall automatically close when power is lost or turned off. The Contractor shall submit the type of lens to the Traffic Engineer for review and approval prior to ordering housing units.

d. Video Processor Unit shall be capable of processing the number of video inputs specified on the plans.

The video processor unit for shall conform to the environmental requirements of 170 specifications. The processor unit and the video communications unit shall operate from -35 to 74 degrees C at 0 to 95 percent relative humidity, non-condensing. The video processor unit
and the video communications unit shall operate from 125 VAC 60 Hz. The processor unit shall be provided with an RS232 port for connection to an external P/C. The processor unit shall detect all licensed vehicles and motorcycles within the camera field of view for each video input. The video processor and the video communications unit shall simultaneously process the required number of video inputs specified on the plans. Each video input shall provide a minimum of 24 detection zones per camera. The processor shall provide functional detection for stop line, presence, and directional detection.

Video processor unit and the video communications unit shall interface with 170/333 controllers/cabinets and provide controller detector inputs when utilized in those cabinets. Cables, harness connectors and cabinet equipment adapters shall be provided as required to interface the video detection unit in the type of cabinet as required by the plans.

Video detection zones shall be programmable by either menu driven operation using a monitor and programming device or PC with Windows XP and NT based software. Either method shall display the detection zones per camera for user programming and provide flexible detection zone placement within the camera field of view. Video processor unit shall store detector configurations created by the user and allow user adjustments of the created detection zones. Video detection equipment shall detect vehicle presence in both day and night conditions and in adverse weather conditions and not be affected by shadows from fixed or moving objects within the detection zone.

Video processor unit and the video communications unit shall be provided with video equipment manufacturers’ recommended transient suppression. Transient suppression shall be provided within the traffic signal control cabinet. Internally installed devices within the video processor unit will also be allowed. Documentation of the type of transient devices will be required to be submitted to the Traffic Engineer for review and approval prior to ordering housing units.

Video processor unit shall be rack mounting in a Model 333 cabinet.

e. Software: Video detection manufacturer’s software shall be provided for detection zone programming and operation if required for detection programming by the video equipment manufacturer. Software shall be compatible with the City’s current Windows system. One software package shall be provided for each video detection system. Software updates/revisions shall be provided to the City as updated by the manufacturer at no additional charge for no less than five years.

f. Video Monitor - A monochrome monitor for viewing the video output from the video processor unit shall be provided in the controller cabinet
regardless of the programming method utilized by the equipment. Monitor shall have a minimum diagonal measurement of 9". Monitor resolution shall exceed the required camera resolution. Monitor shall be provided with connector and cable for connection to the video processor unit. Monitor shall be provided with front panel mounted controls for contrast, brightness, vertical hold, horizontal hold and power on/off. Monitor shall be provided with 125 VAC power cord. Monitor shall fit on controller shelf.

3. Pedestrian detectors shall be pushbutton operated at low voltage (not more than 15 volts AC or 24 volts DC) and shall be "Bulldog" or approved equal.

H. Mast Arm Poles shall be steel primed and painted dark green. All cost for painting shall be included in the price bid for the mast arm pole or strain pole.

Unless otherwise specified, mast arms poles shall be of a one piece or sectional single member, tubular form and shall be round or multi-sided. Multi-sided poles shall have no less than eight sides. The pole shafts and arms shall have a removable cap fastened by no less than 3 screws.

When specified on the plans the Contractor shall furnish a 24 position two pole terminal strip constructed of non-corrosive materials shall be located on the outside of the pole just above the hand hole. A continuously welded frame and removable, weatherproof gasketed cover designed to enclose the hand hole and terminal strip shall be provided. The frame shall be at least 26-inches in height and 5 ½ inches in width. The cover shall be held in place with non-corrosive cap screws located at the top, bottom and side midpoints of the cover, and attachment holes in the frame shall be drilled and tapped.

Mast arm poles shall be designed in accordance with the 1994 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals for a 90 mph wind load and shall include and conform to the following:

- A removable galvanized steel or aluminum pole cap. If field adjusting of pole length is required, pole cap shall fit pole after adjustment. The City will notify the Contractor on a per pole basis whether length adjustment is required.
- A steel "J" hook located within 5 inches of the top of the pole for wire suspension. When pole length has been field adjusted, a "J" hook shall be attached after length adjustment.
- A grounding lug welded to the inside of the pole, easily accessible from the hand hole. Grounding lug shall be designed to secure the No. 6 ground wire by inserting the wire under a set screw type of lug.
1. Mast Arm Poles shall include a mast arm attachment flange plate width and height to be determined by pole size continuously welded to gusset and side plates. Gusset and side plates shall be continuously welded to the pole and each other. The flange plate shall be parallel to the axis of the pole. Flange plates for mast arm poles with two arms shall be positioned 90 degrees to each other. The flange plate shall be fabricated with eight permanently mounted 1½-inch diameter studs for receiving nuts or the flange plate shall be threaded for receiving eight 1½-inch diameter bolts for attachment of the arm. The flange plate shall be suitable for supporting a 75 foot arm and loading. The 4 bolt pattern for the flange plates shall be centered on a design rated according to the pole design. The flange plate and pole shall have a 4 inch wiring hole centered in the pattern. Wiring hole shall be deburred and rounded or fitted with a rubber grommet. Mast arm poles shall have a base plate designed for 4 anchor bolts equally spaced on a bolt circle designed for the pole. All anchor bolts shall be designed with either a threaded plate or plate with nut and washer on the end of the bolt embedded in foundation. The upper ends of anchor bolts shall be threaded and furnished with nuts for pole attachment. Mast arm poles shall be of the following types.

- Single arm poles shall be manufactured with luminaire arm. Mast arm poles shall be 26 feet in height and designed and fabricated (including arm attachment) to support both mast arm and luminaire arm of the length and loading specified herein.
- Dual arm poles shall be manufactured with luminaire arm. Mast arm poles shall be 26 feet in height and designed and fabricated (including arm attachment) to support two mast arms of any length up to 60 feet and a luminaire arm of the length and loading specified herein.

2. Mast arms shall have an arm plate the same width and height as the arm attachment flange plate on the pole and with holes to accommodate the flange plate studs. The amount of arm rise shall not be less than required to prevent the end of the arm from deflecting below the horizontal plane nor greater than required to prevent the mounting height of signal heads from exceeding 19 feet. Mast arms shall be designed site specific and shall be designed to accommodate dead loading and wind loading specified below for rigid mounted signal heads and signs.

a. 40 Feet and less Mast Arm Lengths

Loading concentrated 1 foot from the end of arm shall be a signal w/backplate with 100 pounds of dead load and 13 square feet of area. Three loads, applied at 8 foot increments from the first load to pole attachment, shall be signals w/backplates with 60 pounds of dead load and 8 square feet of area each. The area provided does not take into
account the wind drag coefficient. A drag coefficient of 1.2 should be applied in determining the wind loading.

Two additional sign loads shall be applied as follows: The first load shall be applied 4 feet from end of arm, shall be a sign with 20 pounds of dead load and 8 square feet of area. The second load shall be applied from the pole attachment to the closest signal load, shall be a sign weighing 70 pounds with 30 square feet of area.

b. 50, 60 and 65 Foot Mast Arm Lengths
Loading shall be same as for 30 foot and 40 foot lengths except an additional 8 foot increment loading of 60 pounds and 8 square feet area for a signal w/backplate shall be applied. The area provided does not take into account the wind drag coefficient. A drag coefficient of 1.2 should be applied in determining the wind loading.

c. 70 and 75 Foot Mast Arm Lengths
Loading shall be the same as for the 30 foot and 40 foot lengths except two additional 8 foot increment loads of 60 pounds and 8 square feet of area for a signal w/backplate shall be applied. The area provided does not take into account the wind drag coefficient. A drag coefficient of 1.2 should be applied in determining the wind loading.

d. All Mast Arm Lengths
An additional load concentrated at the midpoint of all arm lengths shall be a video camera and mounting bracket with 22 pounds of dead load and 1 square foot area. The area provided does not take into account the wind drag coefficient. A drag coefficient of 1.2 should be applied in determining the wind loading.

3. Luminaire arms shall be primed and painted dark green steel designed for clamp on installation on the 26 foot poles. Luminaire arm design shall be in accordance with the AASHTO design requirements indicated herein. Clamps shall be provided with stainless steel or galvanized hardware with a minimum of four bolts per clamp for securing the clamps to the pole. Clamps attaching the luminaire arm to the pole shall be designed to fit the section of pole above the mast arm without using spacers or shims for a uniform rigid installation. Luminaire arm shall be a truss type design with a rise of 42 inch to 48 inch. Luminaire arms shall be designed with spacing between the two clamps to fit within the space above the mast arm and 1 foot from the top of the pole.
Luminaire arms shall be one of two lengths, 15 feet or 18 feet. Luminaire arms shall be designed to accommodate a video camera with 22 pounds of dead load and 1 square foot of wind load area concentrated 1 foot from the end of the arm. An additional load applied on the end of the arm, shall be a luminaire with 35 pounds of dead load and 1 square foot of wind load area.
The mast arm shall be equipped with a removable, galvanized steel or aluminum end cap. If field adjusting of mast arm length is required, end cap shall properly fit arm after adjustment. The City will notify the Contractor on a per arm basis whether length adjustment is required.

I. Emergency Preemption

This work shall consist of furnishing emitters, and furnishing and installing all other emergency preemption equipment in accordance with these specifications and as shown on the plans or as directed by the Traffic Engineer.

Emergency preemption equipment shall be optically activated providing all features and functions as the existing equipment within the City’s emergency preemption system and shall fully interface with that existing equipment. Existing equipment consists of 3M’s Model 721 Single Channel - Two Direction Detectors, Model 752 Phase Selectors for 1 and 2-way emergency preemption, Model 754 Phase Selectors for 3 and 4-way emergency preemption, and Model 575 confirmation lights.

Conductor cables between the optical detectors and the phase selector(s)/system chassis shall be in accordance with the manufacturer’s recommendations. Conductor cables between the confirmation lights and the cabinet shall be a 14/4 conforming to the requirements of Section 238 of VDOT’s Road and Bridge Specifications. Transient protection for the cables shall be in accordance with Section 703 of VDOT’s Road and Bridge Specifications.

Mounting assemblies for the detectors, confirmation lights and emitters shall be fabricated from corrosion resistant materials or shall be galvanized.

J. Spread Spectrum Radio Equipment shall be compatible with the City’s current radio system.

Spread-spectrum radio equipment shall be used for bi-directional data communications between master and local intersection controllers.

1. Transceivers shall interface with master and local intersection controllers provided under this contract and conform to the following:
   - FCC part 15.247
   - Frequency range 902-928 MHz
   - Frequency hopping spread-spectrum type modulation
   - 100 milliwatt to 1 watt output power, adjustable in 1 db steps
   - 8 selectable zones each containing 128 frequencies
   - LED status indicators for transmission
   - Standard RS232C data interface with a DB9 connector on the transceiver
• Data rates of 1200 through 115.2k bps asynchronous
• Antenna connector on transceiver shall be type RP TNC
• Transceivers shall be designed to prevent EMI and RFI interference
• Maximum bit error rate of $1 \times 10^{-6}$ at -108 dBm
• Transceivers shall operate from 120 VAC or shall include power supply for conversion of 120 VAC to the transceiver's voltage requirement.
• Transceivers shall be manufacturer's proven model designed for spread-spectrum communications
• Transceiver shall operate within a temperature range of -40 degrees to +70 degrees C and 95 per cent relative humidity at 40 degrees C.

2. Master/repeater antennas shall conform to Parts 15.247 and 15.249 of the FCC Telecommunications Manual for field strength of emissions, be the manufacturer's proven model and conform to the following:
   • Fiberglass, omni directional type
   • 3 or 6 dBd gain, omni directional pattern or; 9 or 13 dBd gain, Yagi directional antenna
   • Frequency Range 902-928 MHz
   • Omni mountable for vertical polarization, Yagi mountable for vertical or horizontal polarization
   • "N" type female connector
   • Minimum wind rating of 150 MPH
   • Direct DC grounding system
   • Stainless steel mounting hardware

3. Remote antennas shall conform to Parts 15.247 and 15.249 of the FCC Telecommunications Manual for field strength of emissions, be the manufacturer's proven model and conform to the following requirements:
   • Directional Yagi type with a minimum of 6 elements, including driven element
   • 9, 10 or 13 dBd gain
   • Frequency range 902-928 MHz
   • Mountable for horizontal and vertical polarization
   • "N" type female connector
   • Stainless steel mounting hardware

4. Antenna cable shall be flexible type coaxial cable conforming to the following:
   • Impedance 50 ohms
   • Type LMR 400 (Times Microwave) or approved equal
   • Feedline loss of the antenna cables shall be no more than 3dB per fifty feet
   • Frequency range 902-928 MHz
   • Black polyethylene or equal outer jacket
   • Minimum bending radius of 1 inch
5. Antenna cable connecting surge suppressor to radio shall be "Superflexible" type coaxial conforming to the following:
   - Impedance 50 ohms
   - RG-58
   - Frequency range 902-928 MHz
   - Minimum bending radius of 1 inch
   - Black polyethylene or equal outer jacket
   - Maximum length to be 6 feet

6. Lightning protection device shall conform to the following:
   - Frequency Range 1.5 - 1000 MHz, D.C. blocked
   - VSWR 1.5:1 Maximum
   - Power Capacity 200 Watts @ 900 MHz
   - Insertion loss of less than 0.1 dB @ 900 MHz
   - Surge 50kA, 8 x 20 microseconds waveform, 500 joules
   - Connectors "N" type female

7. Power Supply shall include connecting cables for connection to remote transceiver and AC power. Power supply shall conform to the following minimum requirements.
   - Input 125 VAC
   - Output 13.5 VDC with circuit overload protector
   - Completely self contained and designed for shelf mounting
   - Power on indicator on front of housing
   - Front panel mounted on/off switch
   - Completely solid state
   - Regulated DC output
   - Manufacturers proven model
   - UL listed device

L. Uninterruptible Power Supply
The UPS system shall be line interactive topology. The UPS shall provide power conditioning and battery backup for clean power to the critical load. The UPS shall protect devices against lightning, spikes, electrical line noise, frequency variations, sag, surges and power failure. The UPS shall be compatible with 170 traffic signal control equipment.

The UPS system including the batteries shall be installed in the traffic signal controller cabinet or a separate cabinet as indicated on the plans. UPS shall be the manufacturer’s standard production model. UPS shall be comprised of a solid state electronic devices, battery bank, automatic bypass-transfer circuit, integral maintenance bypass switch and all necessary hardware and connecting wires, generator connection, and when required a cabinet and cabinet foundation. The system shall include Digital Signal Processing for
direct digital control of all UPS control and monitoring functions. UPS shall be fully power factor corrected while operating in battery backup mode. The UPS system, including batteries and necessary hardware, shall be easily installed/replace without the use of special tools.

UPS shall be designed to operate continuously at rated capacity in the following modes:

- **Normal** – The UPS system shall continuously provide conditioned power to the critical load.
- **Emergency** – In the event of a utility AC power failure, the UPS shall provide uninterrupted power to the critical load. This transition shall be accomplished with no interruption of power to the critical load from either failure or restoration of utility AC power.
- **Recharge** – Subsequent to restoration of utility AC power, the UPS shall automatically recharge the battery system. This shall occur without interruption to the critical load.
- **Bypass** – In the event that the UPS must be taken off-line due to an overload condition or UPS failure, the critical load shall be transferred to the bypass source without interruption of power to the critical load. This bypass switch shall only be utilized for automatic emergency transfers. Retransfer from bypass shall be performed automatically in overload conditions. The use of the bypass switch shall not be required during the manual or automatic retransfer process.
- **Maintenance Bypass** – The UPS system shall be equipped with an external maintenance bypass switch (MBS) to allow safe and reliable maintenance of the UPS system. The bypass shall be of the break-before-make, zero-energy type to ensure maximum load reliability and personnel safety.

Operating temperature range for the entire UPS system shall be -40 degrees C to +70 degrees C, 5 to 95 percent relative humidity, non-condensing.

The UPS shall use a temperature-compensated battery charging system. The charging system shall compensate over a range of 2.5 – 6.0 mV/ °C per cell. The temperature sensor shall include sufficient connecting wire between the temperature monitoring circuit and batteries to monitor the battery temperature. Batteries shall not be recharged when battery temperature exceeds 50 degrees C plus or minus 3 degrees C. An integral system to prevent battery from destructive discharge and/or overcharge shall be provided.

The UPS shall have lightning surge protection compliant with IEEE/ANSI C.62.41.
The UPS shall provide alarm communications to the traffic signal controller for the following conditions:

- **On Battery** – When the UPS switches from AC line voltage to battery power.
- **Low Battery** – When the batteries approach 40 percent of their remaining useful capacity.
- **Timer** – When the UPS has been operating on battery power for a user programmable period of time.

The UPS shall include displays to indicate current battery charge status and conditions, and a battery capacity indicator with readings from 0 to 100 percent. Front panel display(s) shall be provided that indicates the number of times the UPS has been activated and the total number of hours the unit has operated since last being reset. Both the displays shall have a reset function. UPS shall have a DB-9 connector mounted on the front panel for RS232 interface. The system shall come complete with the manufacturer's software installed and connecting cable. UPS software shall be compatible with latest version of Microsoft Windows™. An additional copy of the UPS software on CD-ROM shall be provided to the Traffic Engineer at no additional cost.

1. **Operational:** UPS shall be sized with a minimum load of 1000 watts and sized to provide a minimum of 8 hours of full run-time operation for an intersection comprised of a traffic signal controller cabinet, traffic signal indications and pedestrian signal indications. Traffic signal and pedestrian signal indications are LED only.

The UPS shall be wired so that the Police Panel power disconnect switch will operate properly (disconnect power to the signal system) even when the signal system is operating on battery power.

The maximum transfer time between the disruption of normal utility line voltage and providing a stabilized inverter line voltage from batteries shall be 60 milliseconds maximum. When normal utility line voltage has been restored, the maximum transfer time between switching from inverter line voltage to utility line voltage shall be a maximum of 60 milliseconds.

UPS shall bypass utility line power whenever the utility line voltage is outside of 95 VAC to 135 VAC (± 2 VAC). While operating on battery power the output voltage from the system shall be between 110 VAC and 125 VAC, inclusive; pure sine wave output, ≤ 3 percent THD, 60 Hz ± 3Hz.

In situations where the utility line voltage drops below 95 VAC or is absent, the UPS shall transfer from utility line power mode to battery
backup mode. Once the utility line voltage has been restored to 105 VAC ± 2 VAC for more than 30 seconds the UPS shall transfer from battery backup mode back to utility line mode.

In situations where the utility line voltage exceeds 135 VAC, the UPS shall transfer from utility line power mode to battery backup mode. Once the utility line voltage has been restored at below 125 VAC ± 2 VAC for more than 30 seconds the UPS shall transfer from battery backup mode back to utility line mode.

The UPS shall be equipped to prevent a malfunction feedback to the cabinet or to the utility service. In the event of converter/inverter/charger failure, battery failure or complete battery discharge, the power transfer relay shall revert to the NC (de-energized) state, when the utility line power is connected to the cabinet.

2. Battery System: Battery system shall be shelf-mount, rack-mount, swing-tray mount or a combination thereof. Shelves, racks, trays and vertical mounting channels shall be heavy duty and have sufficient strength to hold the batteries without deforming, bending or breaking. Batteries shall be easily replaced and commercially available as “off the shelf” items. Batteries shall be 12 VDC, deep cycle, and sealed prismatic lead-calcium based AGM/VRLA (Absorbed Glass Mat/Valve Regulated Lead Acid). Batteries shall be certified by the manufacturer to operate over a temperature range of – 25 degrees C to + 74 degrees C. Batteries shall indicate maximum recharge data and recharging cycles. Battery recharge time from protective low cutoff to 80 percent or more of full charge capacity shall not exceed 20 hours. Batteries shall be provided with appropriate interconnect wiring and corrosion resistant mounting trays and or brackets.

Batteries shall be stored below the level of all traffic signal control electronic equipment or in the lowest space within the cabinet. Batteries shall not be stored in direct contact with concrete.

The number and amp-hour rating for the batteries shall be determined by the manufacturer of the system to provide the required voltage/wattage while on battery power for the time period referenced (8 hours).

3. Battery Harness: Battery interconnect wiring shall be via a two-part modular harness.

a. Part I shall be equipped with red (+) and black (-) 12 inch cabling that can be permanently connected to the positive and negative posts of each battery. Each red and black pair shall be terminated into an Anderson-type power connector or equivalent.
b. Part II shall be equipped with the mating Anderson-type power connector for the batteries and a single, insulated power pole style connection to the inverter/charger unit. Harnesses shall be fully insulated and constructed to allow batteries to be quickly and easily connected in any order to ensure proper polarity and circuit configuration.

Power connectors may be either one piece or two-piece. If a two-piece connector is used, a locking pin shall be used to prevent the connection from separating.

The lateral length of the harness between battery connectors shall be a minimum of 12 inches.

All battery interconnect harness wiring shall be UL Style 1015 CSA TEW or Welding Style Cable or equivalent, and shall be of the proper gauge with respect to design current and have a sufficient strand count for flexibility and ease of handling.

All battery terminals shall be covered and insulated with molded boots to prevent accidental shorting.

4. Wiring: Wiring for the UPS shall be sized in accordance with the NEC and shall conform to the requirements of Sections 238, 700 and 703 of VDOT’s Road and Bridge Specifications.

The UPS equipment cabinet or the traffic signal controller cabinet shall be equipped with a generator connection. The connection access point shall be located on the AC power side of the cabinet and shall have a fully gasketed, weatherproof, lockable door. The door shall be equipped with the City’s standard police lock. This connection shall be wired such that power from the generator and the utility line passes through the UPS system and when utility line power has been restored, the generator shall be automatically bypassed to utility line power. The connector shall be a watertight, flange inlet, male, 30-amp, 125 VAC Hubbell Model # 2615 NEMA L5-30 or approved equal, twist lock type receptacle, and shall be approved by the Traffic Engineer.

Wiring panels and terminal blocks shall be neatly finished and clearly and permanently marked with identifications applied by silk screening. Conductors shall be neatly arranged and bundled in groups with cable ties. The bundled conductors shall not obstruct access to other circuits and terminals in the cabinet. A listing, indicating terminal numbers with a description of their use, shall be attached to the cabinet door and overlaid with a clear, plastic covering. Edges of the plastic overlay shall be sealed with a clear exterior grade, waterproofing compound. Unless cable is
passing through the cabinet uninterrupted, incoming and outgoing conductors shall have each wire connected to terminal post positions.

5. Documentation: The Contractor shall provide five prints of the control circuit diagram. Prints shall be produced from the original diagram and shall be clear and legible. The Contractor shall install two copies of the circuit diagram inside the traffic signal controller cabinet or in the UPS cabinet in the readily accessible water resistant enclosure and shall furnish three additional copies to the Traffic Engineer. The Contractor shall provide three sets of the following: equipment list, operation and maintenance manuals, board level schematic diagram and wiring diagrams of the UPS and battery data sheets. One copy of these materials shall be stored in the water resistant enclosure within the traffic signal controller cabinet or the UPS cabinet and two sets provided to the Traffic Engineer.

6. Cabinet: When a separate cabinet is required, the cabinet shall house the batteries, wiring, related equipment, and the UPS, which includes converter/inverter/charger unit, power transfer relay, power management unit, manually operated bypass switch and other control panels and wiring harnesses. The cabinet shall be located as close as possible to the traffic signal controller cabinet.

Cabinet for UPS shall be weatherproof and constructed of welded sheet aluminum, 0.125-inch minimum. Cabinet mounting attachments shall be durable, corrosion resistant, compatible with the aluminum of the cabinet or isolated from it and of heavy-duty construction. Cabinets shall be at least 54 inches in height, 44 inches in width, and 24 inches in depth. The maximum width and depth shall be such that the cabinet will fit entirely on the standard CF-1 foundation. The cabinet bolt pattern shall be rectangular, with dimensions of 40-5/8 inches in width and 18-1/2 inches in depth. Anchor bolts shall be 3/4-inch in diameter and at least 16 inches in length with a 5 inch "L" bend. The UPS cabinet door shall open away from traffic and shall be hinged to open in the opposite direction of the traffic signal controller cabinet it is used with, such that when the traffic signal controller cabinet door and the UPS door are both opened simultaneously the doors will not interfere with one another nor will they block the entrance to either cabinet.

a. Doors: Cabinet doors shall provide full access to the cabinet interior and shall have gaskets to ensure weatherproofing. The door shall be equipped with the City's standard Corbin lock No. 2. Two keys for each cabinet shall be provided to the Traffic Engineer. Hinges shall be stainless steel and continuous. Doors shall have a doorstop arrangement that will allow it to be firmly positioned at 90 and 135 degrees, ± 10 degrees. The locking system for cabinets shall be a three-point draw roller system. Rollers shall be fabricated from nylon
with a diameter of at least 8/10 inch. The door opening shall be double flanged on all four sides.

The door shall have a screened and louvered vent design to prevent rain entry, with a standard size furnace vent filter. The filter tray shall be sized to house and secure the filter in place. The screen shall be constructed from at least 0.031-inch aluminum with 1/8 inch diameter openings positioned on 3/16 inch staggered centers. The screen shall be placed on the inlet side of the filter and held in place by the filter or silicone adhesive.

b. Interior: The interior of cabinet shall be of sufficient size to provide adequate ventilation of the equipment housed therein. Cabinet shall contain at least three adjustable shelves or equivalent supports, with enough space to hold UPS, batteries, battery trays and brackets, wiring and related equipment. Vertical mounting channels for the shelves shall be continuous and shall allow for adjustable shelf placement ranging from 5 inches from the bottom to 5 inches from the top of the cabinet. Shelves and vertical mounting channels shall be heavy duty and have sufficient strength to hold the batteries without deforming, bending or breaking. Wiring panels and terminal blocks shall be neatly finished and clearly and permanently marked with identifications applied by silk screening. Conductors shall be neatly arranged and bundled in groups with cable ties. The bundled conductors shall not obstruct access to other circuits and terminals in the cabinet.

A water resistant enclosure to store documentation shall be securely attached to the UPS cabinet with studs welded to the cabinet and nuts. The enclosure shall have non-corrosive metal grommets for use with the studs.

A listing, indicating terminal numbers with a description of their use, shall be attached to the UPS cabinet door and overlaid with a clear, plastic covering. Edges of the plastic overlay shall be sealed with a clear, exterior grade waterproofing compound. Unless cable is passing through the cabinet uninterrupted, incoming and outgoing conductors shall have each wire connected to terminal post positions.

A screened air exhaust opening under the top overhang shall be provided. Two thermostatically controlled vent fans with a screened guard in the top section of the cabinet each with a capacity of exhausting at least 100 CFM shall be provided. The thermostat shall be adjustable from 80 degrees F to 130 degrees F. Degree markings shall be indicated on the thermostat in 10-degree increments. The fans shall be AC operated from the same line output of the Manual Bypass Switch that supplies power to the Traffic Signal Control
Cabinet. A two position terminal block shall be provided on the fan panel. Proper over current protection shall be provided for the fan circuit.

A fluorescent lamp receptacle, fluorescent lamp (ordering code #F20T12/D), and an ON/OFF door switch shall be located in the cabinet so that it provides unobstructed illumination of the interior of the cabinet. A toggle switch and a momentary switch operated by the door shall be connected inline for operation of the lamp. The lamp toggle switch shall be located adjacent to the fluorescent lamp and labeled “LAMP” with “ON”, “OFF” indications. The fluorescent lamp and switches shall be AC operated from the same line output of the Manual Bypass Switch that supplies power to the Traffic Signal Control Cabinet. Proper over current protection shall be provided for the fluorescent lamp circuit.

Wiring for the lamp, fans and other auxiliary equipment shall be connected via terminal blocks.

Wiring from the UPS to the traffic signal controller cabinet shall be accomplished via a conduit passing through the UPS foundation, underground to a spare conduit in the traffic signal controller cabinet.

c. Cabinet Foundation: The cabinet foundation and cabinet shall be installed in accordance with CF-1 of VDOT’s Road and Bridge Standards and with Section 700 of VDOT’s Road and Bridge Specifications.