City of Richmond, Kentucky

Access Management and Roadway Manual

January 2015

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Introduction

The continuing growth and development in the City of Richmond has generated the need to expand and update many of the city's regulations over the past few years. The Comprehensive Plan outlined many of the near-term and long-term goals to provide better services to the citizens of Richmond. This manual expands and updates the City of Richmond transportation regulations, both for new development as well as a tool to guide government-funded infrastructure improvements.

The layout of this document is predicated on development of a procedure for planning, layout, design and construction of a transportation system that includes the pedestrian, bicyclist, trail enthusiasts, and motor vehicle uses. The City of Richmond must work with the Kentucky Transportation Cabinet, the Eastern Kentucky University, Madison County, railroads, utility companies and others to develop a transportation system that will meet the increasing demands of an expanding city. The City of Richmond has included links to various websites for further information about access management topics.

Primary documents used in development of this report include the Lexington-Fayette Urban County Government (LFUCG) Subdivision Regulations; the LFUCG Engineering Manuals; the Access Management Manual from the Transportation Research Board; A Policy on Geometric Design of Highways and Streets, "The Green Book", and the Guide for the Development of Bicycle Facilities all from the American Association of State Highway and Transportation Officials (AASHTO). These are all regional or national standard design guidelines and practices for access management, design and construction of roadways. Additional references are located in Appendix B.

This manual is broken into two distinct segments, plus Appendices. The first segment includes the development of an Access Management manual that provides guidance on driveway and intersection spacing, including development of a transportation plan and a bike/trail plan that will help guide future development as well as provide the framework to develop a complete plan throughout the existing community.

Access Management Manual

Access management is a set of techniques that the City of Richmond can use to control access to highways, major and minor arterials, collector and other roadways. These techniques are designed to increase the capacity of roads, manage congestion and reduce crashes.

Access management relies on the use of a hierarchy of road types to provide varying levels of transportation access to adjacent land uses, and maximizes the efficiencies of the transportation system. Some techniques used include management of driveway access to all highways, spacing of signalized intersections, use of medians to control left turns, deceleration lanes on major highways, interconnectivity of collector and arterial roads to reduce unnecessary trips. Creation of land use policies to restrict access is also critical to the success of access management.

The transportation plan and bikeway/trail plan included within the Access Management Manual will guide future growth and development in Richmond. The development of these two plans was accomplished by means of town hall meetings to get public comments and development of alternative plans that were evaluated to gain consensus of a final document. These plans are dynamic and will require updating every five years, or whenever a significant roadway milestone has been accomplished.

Roadway Design Manual

The Roadway Design Manual was developed to ensure that all public roads and trails are constructed to a uniform standard, which will ensure all public works facilities have been constructed so that they meet a 20-year design life that is commensurate with their function and need. The consistency of design and construction will also improve management of maintenance costs in the future, hopefully reducing the potential for premature failures of roadway or trail pavements.

This manual is based upon design practices that have been used in many cities in the United States, and are endorsed by numerous public agencies and national design and construction organizations.

Section A - Access Management Manual

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Chapter 1
Overview

1.1 Access management is a set of techniques that the City of Richmond can use to control access to highways, major and minor arterials, collector and other roadways. Access management includes several techniques that are designed to increase the capacity of these roads, manage congestion and reduce crashes.

Techniques used to improve the capacity of roads are grouped into the following categories:

- Provide a specialized roadway system hierarchy – Functional Classification
- Control driveway location, spacing and design, including joint access points
- Increase and manage distance between signalized intersections
- Preserve the functional areas around intersections and interchanges
- Limit the number and location of traffic conflicts
- Use of exclusive turning lanes or frontage roads
- Use of median control of access
- Land use policies that limit right of way access to highways.
- Improve the connectivity of the transportation system

The purpose of access management is to provide vehicular access to land development in a manner that preserves the safety and efficiency of the transportation system.

1.2 Benefits of Access Management

Roads are an important public resource. It is not wise or practical to allow the function of major arterial roadways to deteriorate by permitting full access without restrictions. Upgrading and improving these roads is becoming more expensive to construct and consumes valuable land reserves.

Access management is good business. Businesses, motorists, individuals, government and the community receive significant benefits from access management.

- Businesses benefit from a predictable traffic pattern, reduced delivery delays, lower transportation costs, stable property values
- Motorists face fewer traffic conflicts, fewer delays, and an increase in safety
- Pedestrians and cyclists benefit from a more predictable motorist travel pattern, and alternative routes
- Government benefits from lower investment costs, higher efficiency of traffic movement, less construction inconvenience
- Communities benefit from a safer transportation system, reduced right of way acquisition, preserve the roadway investment cost

Access management programs can stop the cycle of functional obsolescence of transportation facilities. However, the transportation and land use cycle can only be managed by addressing both the transportation system and the adjacent land development.

1.3 How is Access Management Accomplished?

Access management is accomplished by designating an appropriate level of access control for each of a variety of facilities in a transportation system. Local residential roads are allowed full access, while major highways and freeways allow very little. In between are a series of road types that require standards to help ensure the free flow of traffic and minimize crashes, while still allowing access to major businesses and other land uses along a road.

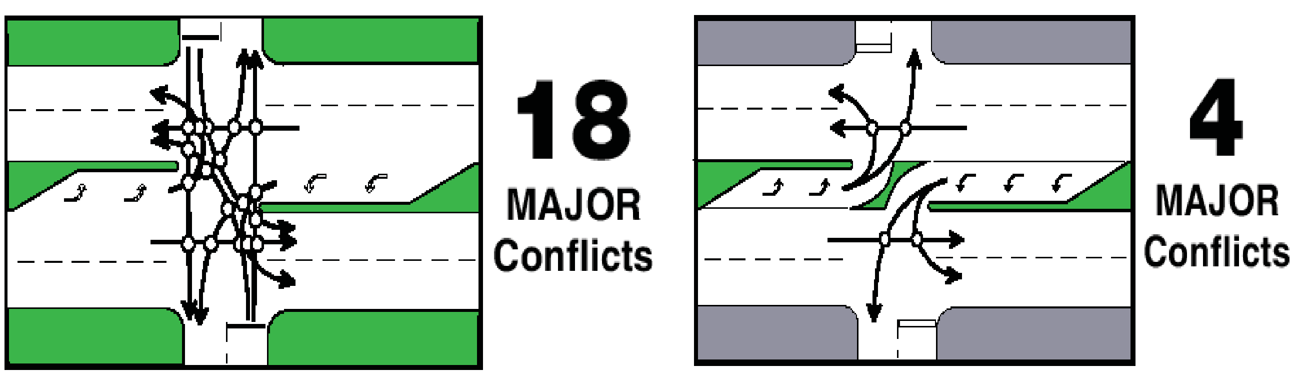
Access management practices must also be coordinated through the City of Richmond Comprehensive Plan, the Development Ordinance and coordination with the Kentucky Transportation Cabinet on state-maintained roadways.

1.4 Access Spacing

Each new access point brings a significant number of conflict points into the traffic stream. Access management programs should establish minimum requirements for access spacing.

Figure 1.1 - Conflict Points

Full Median Access Directional Median Opening



Spacing criteria must be developed for the following items:

- signalized access connections and street spacing
- unsignalized access connections
- corner clearance
- access to crossroads at interchanges
- spacing between highway interchanges

1.5 Signalized Access Connections and Street Spacing

Closely spaced or irregularly spaced traffic signals on arterial roadways result in frequent stops, unnecessary delay, increased fuel consumption, excessive vehicular emissions and high crash rates.

Signalized access connections should be spaced as far apart as practical along arterials. A series of signals along one or more arterials should also be interconnected and working in a coordinated fashion.

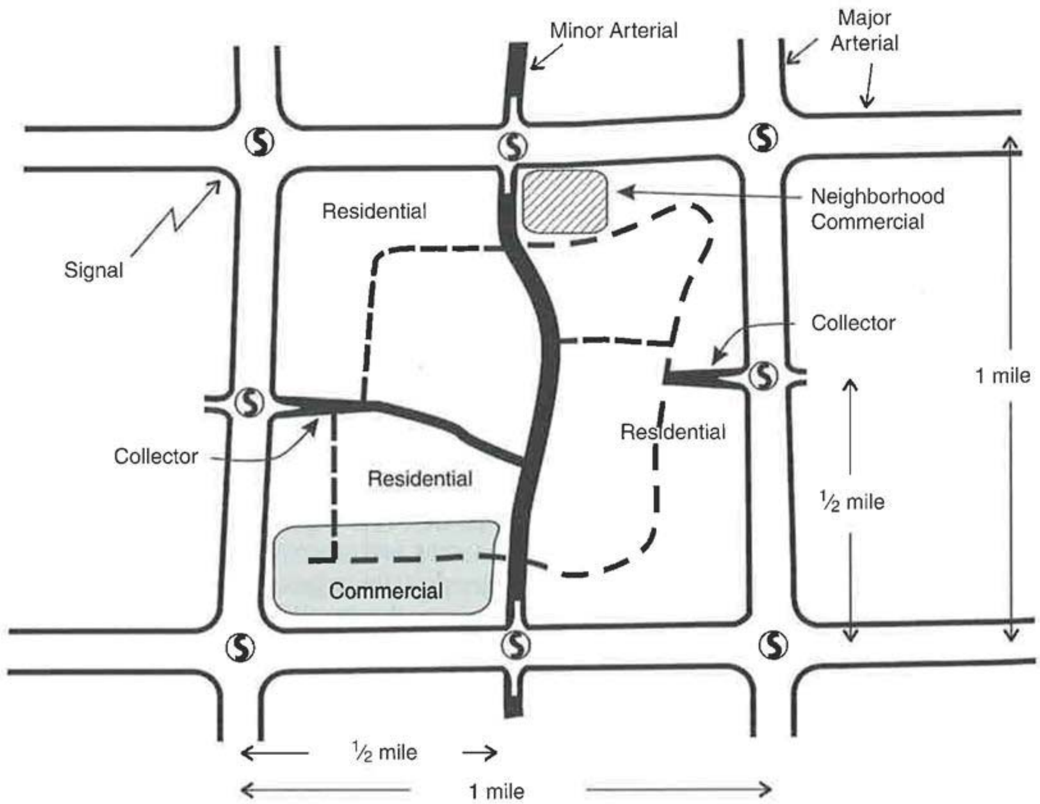
New signalized access points will require a traffic study to consider the effects of the signal on the roadway operation, including increased delay, crash rates, spacing and adverse effects on the green band width of the signal progression aspects of the arterial.

Most signals will be installed on the state highway system and will require approval of the KYTC for installation.

1.6 Street Spacing

Capacity at the intersection of two major urban arterials ultimately can become a problem as an area develops and traffic volumes increase. Spacing major arterials at multiples of the adopted signal spacing facilitate operation of the major arterial-to-major arterial intersections by maximizing traffic flow and minimizing delay. For example with a ½ mile spacing interval, major arterials would be spaced 1 mile apart, allowing continuous minor arterial or collector streets to be located between the arterials. Alignment of the collector streets depends on subdivision layout. Ideally, the pattern of local and collector streets within residential areas would discourage through traffic from using the residential streets as an alternative to the arterials. Figure 1.2 illustrates the relationship between the various functional classifications of roadways.

Figure 1.2 - Corridor Land Use and Transportation Concept



1.7 Access Management Corridor Plans

The Transportation Plan in the Richmond Comprehensive Plan recommended implementation of access management plans for several roadways, including the Robert Martin Bypass and the Eastern Bypass, and several other roadways.

An access management corridor plan for specific roads can be beneficial to guide future development and lay the groundwork for the transportation circulation plan for the entire corridor.

Regional examples of such plans include Richmond Road and Man o War Boulevard, in Lexington. Both facilities had access management plans approved by the Urban County Council to manage access before development was completed along both roadways.

Access management plans have also been completed for existing roadways that have congestion problems. Examples of plans that have been completed for already existing problem locations include the US 31W Memorandum of Understanding in the Louisville area, and a draft for the Nicholasville Road US 27 Access Management Plan that has been completed but not formally approved, in the Lexington area.

This manual will provide the basic principles of access management, but a specific plan for any of the existing or proposed roads in Richmond will be more effective and control future development of the corridors. Such plans are usually welcomed by development because they know before they even start a development what the ground rules are for access to their developments.

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Chapter 2
Functional Classification

2.1 Overview of Standards by Street Classifications

Proposed streets must conform to adopted City of Richmond's standards and policies for design and construction. The only exception to these requirements is when the City deems it necessary to apply different standards in an effort to:

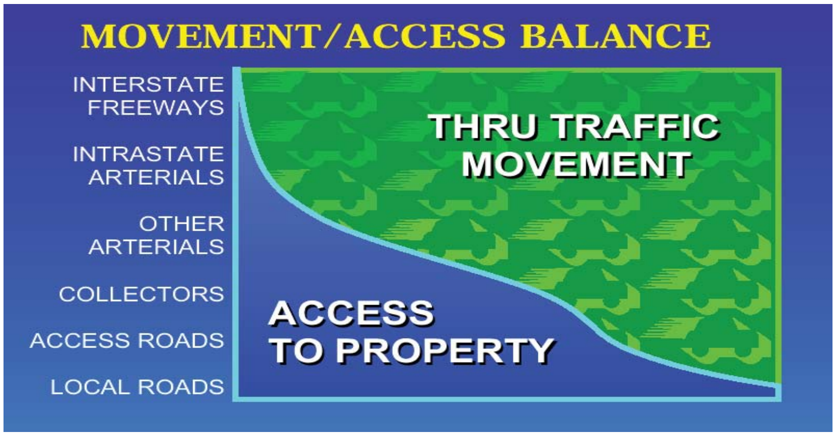
- Preserve trees or other natural features
- Minimize grading or impervious surfacing
- Accommodate utilities, landscaping, or other street side facilities
- Increase the suitability of the design or construction to the terrain, soil, surface drainage, groundwater, or anticipated traffic load or speed
- Achieve specific community goals deemed beneficial to the City of Richmond

Streets shall be related to topography and shall generally provide for the continuation of existing or dedicated streets in adjoining or nearby tracts, and provide for connection to adjoining unsubdivided tracts, especially those which would otherwise be land-locked. Expressways and arterials shall not penetrate or bisect existing or proposed neighborhoods, but rather, shall be located as appropriate boundaries for such. Collectors shall carry traffic from arterials into neighborhoods. Locals shall carry traffic from collectors into the neighborhood for the primary purpose of access to individual properties.

2.2 Roadway Classification

It is important to classify the roadways within the City to effectively manage the traffic on those roads. Within any community there are different types of streets, which are planned and constructed to serve different purposes. On one end of the scale, the multi-lane freeway is designed to carry high volumes of traffic at high speeds over relatively long distances. No direct access between these freeways and the land, which abuts them, is permitted. On the other end of the scale is the local residential cul-de-sac, whose function is to provide access to and from the property abutting it and to provide the first link between that property and the entire roadway network. The bulk of the streets in a community, however, do not fit neatly into either of these two categories. Most streets provide, in varying degrees, for both the through movement of traffic and access to the property abutting those streets but, unfortunately, these two functions often conflict with one another. New developments need adequate access to the property in order to be viable but each additional access point lessens the capacity of the roadway to carry traffic volumes. This compromise can be accomplished through the application of a comprehensive policy based on the principles of access management. Figure 2.1 shows the correlation between access and functional class.

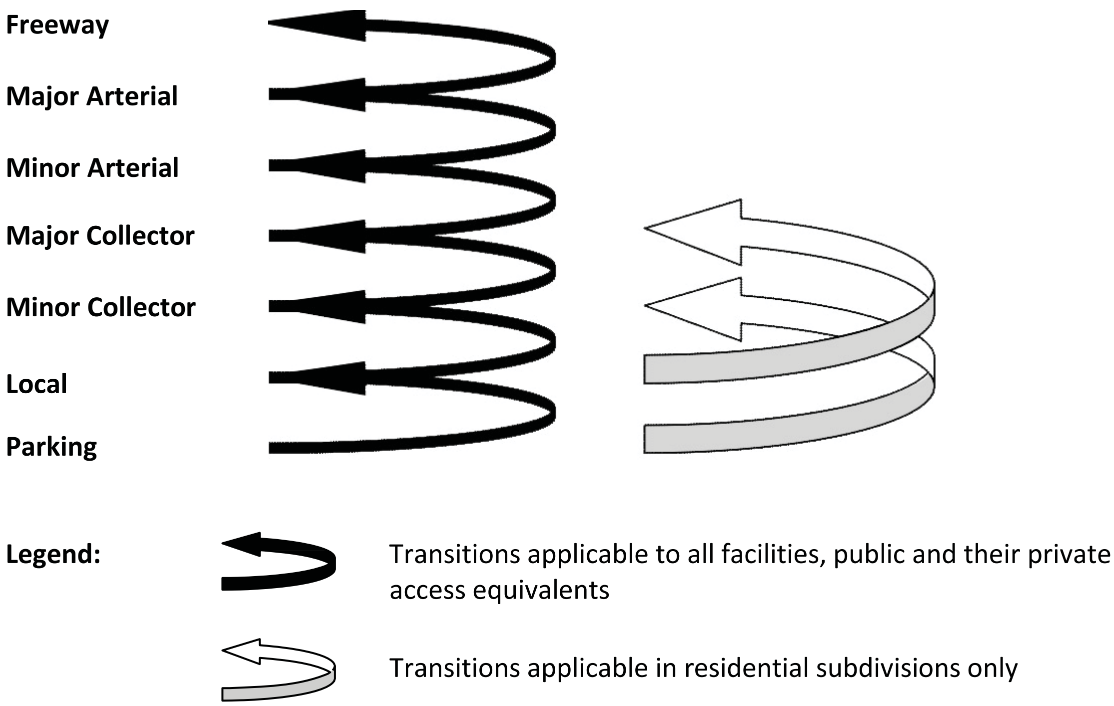
Figure 2.1 – Functional Hierarchy



As shown, local/residential roads can function with the highest number of access connections. However, a freeway should have the greatest control of access, limiting the connections to major crossroads. The actual roadway structure is also important in the success of a roadway network. Local roads should feed to collectors, which should feed into arterials, etc. This is shown in Figure 2.2 below. This street hierarchy is important for various reasons. One principal reason is to keep high volume through traffic on major arterials and keep them from using local roads in neighborhoods.

The following sections describe how Richmond streets will be identified in the various categories. Maps will show the roadways in various colors, and a table of classification of all Richmond streets is included in the Appendix section of this report.

Figure 2.2 – Access Relationship between Functional Classes



2.3 Street Classifications

Streets are defined as a vehicular way, a general term used to describe a right-of-way that provides a channel for vehicular, bicycle and pedestrian movement between certain properties and/or locations in the community. A street may also provide space for the location of underground or aboveground utilities.

For transportation purposes, streets provide two primary functions: *movement* between various origins and destinations at reasonable volumes and speeds, and access to individual parcels of land (specifically driveways connecting streets and private property). These two functions are often in conflict with each other; thus street classifications must be used to balance these needs.

In planning a street network for the City of Richmond, the following street classifications, by function, are utilized:

- **Expressways**

  Expressways are used only for movement of vehicles, providing for no vehicular or pedestrian access to adjoining properties; interchange of traffic between an expressway and other streets is accomplished by grade separated interchanges with merging deceleration and acceleration lanes, and no at-grade intersections are permitted. Expressways generally carry higher volumes, require greater right-of-way width, and permit higher speed limits than any other class of street, and should be depressed in urban or urbanizing areas. Arterials are the only class of street that generally should be connected with expressways at interchange points. Expressways will not be addressed in this guidance manual; the Engineer is referred to AASHTO's *A Policy on Geometric Design of Highways and Streets*, and/or KDOH's *Design Manual* for background and information with regards to expressways.

- **Arterials**

  Arterials are used only for the movement of vehicles, and should not provide for direct vehicular access to adjacent properties. Bicycle usage of arterials should be limited to designated bicycle/multi-use paths or bicycle lanes. Pedestrian use of arterials should be limited to designated bicycle/multi-use paths or sidewalks. Interruption of traffic flow should be permitted only at street intersections that should contain medians, deceleration lanes, and left turn storage lanes. Arterials are the link between expressways and collectors, and rank next to expressways in traffic volumes, speed limit, and right-of-way width.

  Arterials may be further divided into two classes, "Major" and "Minor".

  - **Major Arterials** - carry the major portion of trips entering and leaving the urban area, as well as the majority of through movements desiring to bypass the central city. In addition, significant inter-area travel such as between the downtown and outlying residential areas, between major inner city communities or between major suburban centers is to be served by this class of facilities.

  - **Minor Arterials -** interconnect with and augment the principal arterial and provide service for trips of moderate length at a somewhat lower level of travel mobility.

- **Collectors**

  Collectors are used both for vehicles and to provide access to adjacent properties. Access to adjoining properties should be planned and controlled so that minimum disturbance is made to the traffic moving efficiency of the Collector. Bicycle usage of Collectors should be limited to designated bicycle/multi-use paths, bicycle lanes, or streets designated as bicycle routes that provide a widened outside land or a paved shoulder that can be utilized by bicyclists. Pedestrian use of Collectors should be limited to designated bicycle/multi-use paths or sidewalks.

Collectors are streets that are designed to interconnect the city as a whole, as well as to provide a link between arterials and local streets. Collectors generally rank next to arterials in traffic volumes, speed limits, and right-of-way width.

- **Locals**

Locals are used primarily to provide access to adjacent properties. Vehicles moving on these streets should have an origin or destination in the immediate vicinity, and all types of through traffic should be eliminated through initial design of its connections with other streets. Local streets are the primary link between trip generation points (homes, offices, stores, work) and collector streets. Locals have the least right-of-way, the lowest speed limit, and the least amount of vehicular traffic. Local streets can be subdivided further into five sub-classes, listed below.

  - **Continuing**: Are local streets having two open ends; each end generally connects with different streets; one or more other streets may intersect it between its two open ends; and property fronts on both sides of the streets.

  - **Service Roads**: Are local streets that run parallel to a street with a higher classification on one side and run parallel to properties requiring access on the other side. A service road generally has two or more open ends, connecting at street intersections that run perpendicular to the service road and its adjacent street of higher classification. In this way, a service road provides an access route to properties adjacent to higher classification streets while at the same time reducing the number of access points from these properties onto the higher classification streets. Generally, in a given block, one or no access points are provided directly to the higher classification streets, but multiple access points are provided onto the adjacent properties.

  - **Loop**: Are local streets forming a “U” shape and having two open ends; each end generally connects with the same street; no other streets generally intersect between its two ends, and property fronts on both sides of the street.

  - **Cul-de-sac**: Are local streets having only one open end providing access to another street; the closed end provides a turn-around circle for vehicles, no other street generally intersects between the two ends, and property fronts on both sides of the street.

  - **Stubs**: Are local, closed end streets that are only acceptable as temporary street conditions. Stubs are similar to cul-de-sacs except that they provide no turnaround circle at their closed end. Stub streets shall only be used when a future street continuation to an adjacent undeveloped property is planned.

- **Alleys**

  Alleys generally have two open ends, each end connects with different streets, and property generally backs onto both sides of the alley.

2.4 Functional Classification of Existing Streets for the City of Richmond

The City of Richmond has assigned a functional classification of all existing roads within the city based on traffic data, existing land use and zoning and current access conditions. This map is an updated version of that shown in the 2011 Comprehensive Plan. It is identified as Figure 2.3 – Functional Classification of Existing Streets in Richmond.

2.5 Functional Classification of Existing and Future Streets for the City of Richmond

In order to plan for future growth of Richmond and to prepare the transportation system for future growth and development, the city held several Town Hall meetings to solicit public input for improvements that it felt necessary to ensure that Richmond was prepared for future traffic and roadway capacity needs. Issues that were discussed at the meetings included connectivity of subdivisions for circulation and safety, roadway capacity, problem locations or intersections, bike lanes, shared-use trails, and other issues that the public was concerned about.

The study area for the future plan included the entire city limits of Richmond plus any sewerable land immediately adjacent to the existing city limits. In some locations potential roadway connections were made outside of these areas in order to complete a comprehensive traffic circulation system for the future. These would be the most important locations to plan for an enhanced access management roadway system.

The issue of bike routes, bike lanes and shared-use trails was an important component of the proposed roadway system also. There were several recommendations for enhanced bike lanes and trails that came from the town hall meetings. The bike needs of Richmond range from recreational, commuter, student driven destinations, and intercity routes that would link Richmond with surrounding tourist destinations and other cities in the region. A long term goal would be to develop a system of bike trails that would link with cities in all directions of Richmond and provide an important tourism component of the economy that is currently nonexistent.

The proposed roadways on the maps are general alignments only. No alignment or corridor studies have been completed on any of the roadways. The refinement of actual roadway locations and alignment will be completed by the City of Richmond, at a time when future development is imminent.

It is recognized that some of the proposed roadways will be constructed within the next five years. Other major roadways may not be constructed within the next 20 years, but it is important to plan current development with the entire proposed roadway structure in mind. This will reduce the potential for short-sighted development and provide the framework for an overall transportation system that meets the needs of Richmond. The proposed functional classification system for the City of Richmond is shown in Figure 2.4 – Proposed Functional Classification of Existing and Proposed Streets in Richmond, Including Bike Lanes and Shared Use Trails.

Figure 2.3 – Functional Classification of Existing Streets in Richmond ***(Map is for illustrative purposes only. Go to online map for more detail)***

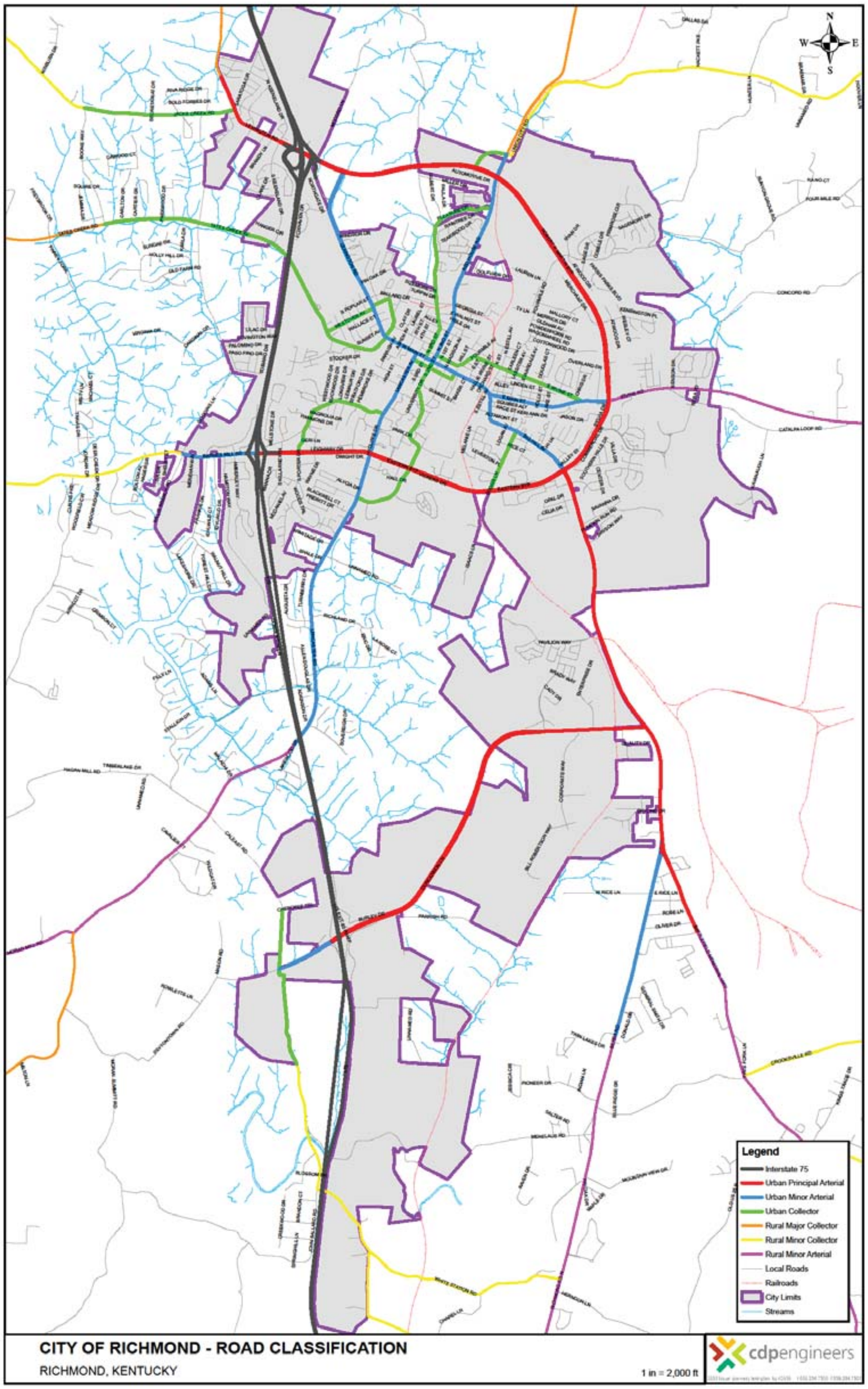
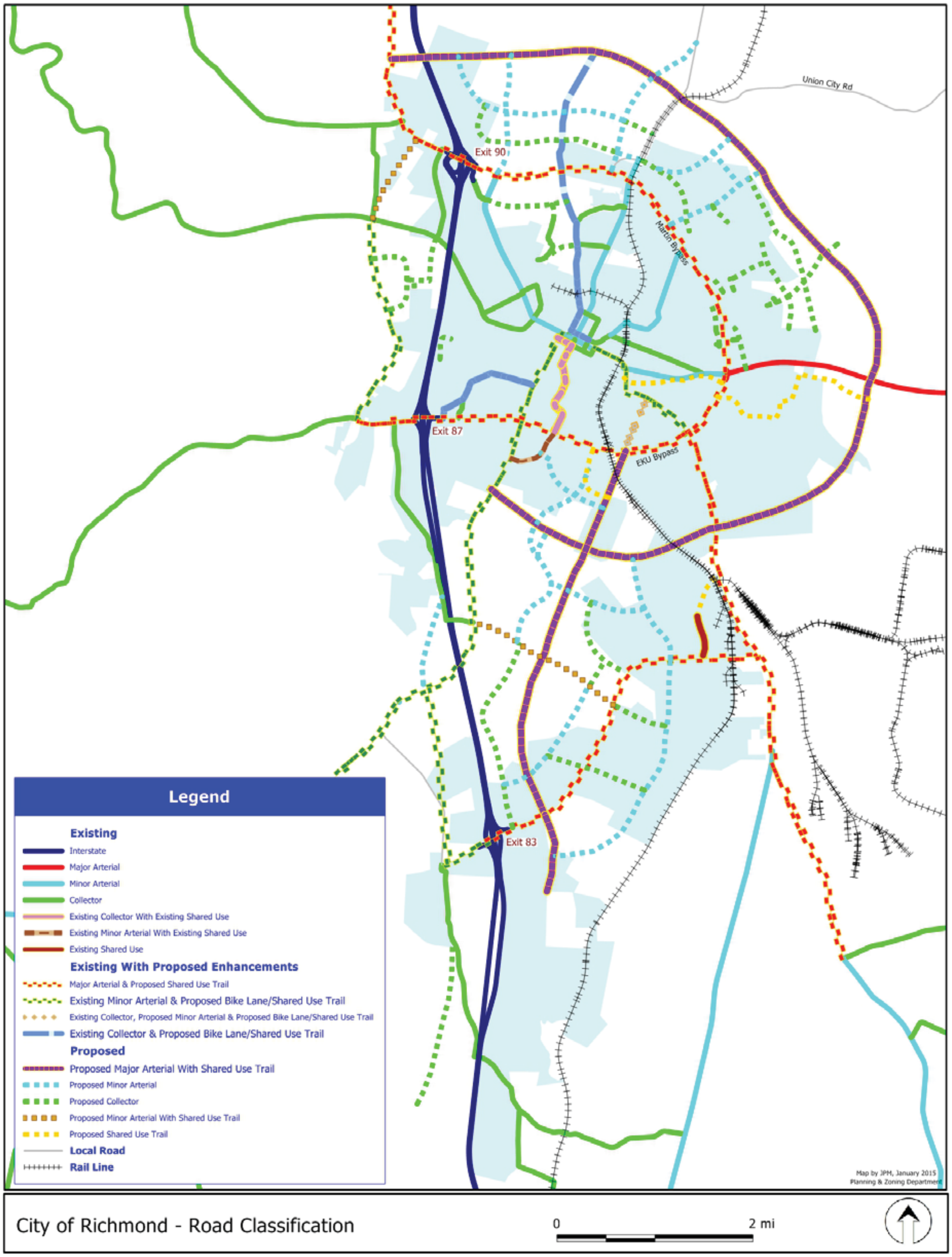


Figure 2.4 – Proposed Functional Classification of Existing and Proposed Streets in Richmond, Including Bike Lanes and Shared Use Trails ***(Map is for illustrative purposes only. Go to online map for more detail)***



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Chapter 3
Street and Driveway Access, Site Layout and Land Use

3.1 Introduction

The appropriate location of access points is critical to roadway efficiency, driver and pedestrian and cyclist safety. Critical factors that must be considered include provision of adequate sight distance, avoiding conflicts in the functional area of intersections and interchanges, and observing the hierarchy of roadways and intersections. Further information about street and driveway spacing is provided in subsequent chapters.

3.2 Coordination between Land Use Policies and Access Management

Land use and access management policies must be coordinated to achieve the proper and effective control of intersections, driveways and other traffic control practices. This manual provides the technical guidelines for location of these facilities and provides Planning and Zoning with the tools to direct local residential and commercial development to meet those guidelines. The Development Ordinance and the Comprehensive Plan must also be coordinated to enforce the policies and guidelines set forth in the manual.

3.3 Roadway Characteristics

Intersections and driveways share common access characteristics. The major differences between them are that intersections serve public or public streets and driveways serve private property parcels. They are both considered access connections. Operational characteristics that influence the location and design of access connections are as follows:

- <u>Speed:</u>
  Stopping distance, intersection sight distance, decision sight distance, maneuvering distance all increase rapidly as speed increases.

- <u>Volume and traffic flow:</u>
  Traffic volumes on major roadways in urbanized areas are commonly higher than in rural areas. Urban streets commonly experience higher traffic volumes and slower speeds in peak periods than off peak periods. In addition, traffic flow is affected by traffic signals, which result in large numbers of vehicles moving in platoons with a much smaller number of vehicles distributed between the platoons.

3.4 Site Characteristics

Good site design should have a circulation pattern that does not conflict with the building or parking lot layout, should fit the terrain and conform to the overall site plan. Landscaping and parking requirements, space desired for future expansion, buffers and other development requirements must also be properly considered.

Flexibility in the location of access points, building site, circulation and other considerations, increases as the size of the property increases; thus, it is easier to develop a comprehensive access management plan for large sites. For small parcels on major roads, joint access, inter-parcel circulation and service roads can be used to provide a site access and circulation plan that serves as an alternative to direct roadway access.

3.5 Sight Distance

Each access point contains several potential vehicle conflicts. Providing adequate intersection sight distance at access connections ensures that drivers can enter or cross a roadway safely. Adequate sight distance also allows drivers approaching an access connection to see a vehicle waiting at the connection or entering the roadway and safely take evasive action if necessary. Access points should be planned and located to provide as much sight distance as possible.

Three types of sight distances are involved in the location and design of access connections:

- Stopping sight distance: the sight distance required for a driver to perceive and react to a discernible hazard (an object equal to or greater than 6 inches high) and then brake to a stop before reaching the hazard.

- Intersection sight distance: the sight distance required for drivers to safely make a left or right turn from an access connection, or to cross a roadway, or for a driver to safely make a left turn from a roadway into an access connection.

- Decision sight distance: the distance required by a driver to ascertain and safely respond to an unexpected, difficult, or unfamiliar situation. Decision sight distance addresses the need to provide drivers, especially unfamiliar drivers, with enough distance to safely turn into the desired location and is an integral part of the access location and design of large traffic generators. A common approach to providing decision sight distance is with advance signing (i.e., "Lancaster Road, Next Signal").

The operator of a vehicle approaching an intersection at-grade should have an unobstructed view of the entire intersection and sufficient lengths of the intersecting road to permit control of the vehicle to avoid collisions. A basic requirement is that drivers must be able to see traffic control devices well in advance of performing required actions.

The minimum stopping sight distance at any point within an intersection shall be consistent with the design speed at that point. Listed below are the minimum stopping distances. Higher values should be used whenever possible. Refer to Chapter IX, AASHTO's *A Policy on Geometric Design of Highways and Streets* for additional information on sight distance.

Figure 3.1 – Stopping Sight Distance

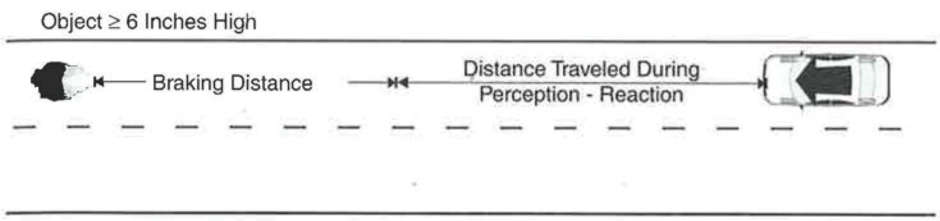


Table 3. 1 – Minimum Safe Stopping Distance

Design Speed (MPH)	10	15	20	25	30	35	40	45	50	60
Safe Stopping Distance (Feet)	45	75	125	150	200	250	325	400	475	650

Reference: Adapted from ITE and AASHTO standards.

There are four types of controls that apply to at-grade intersections. These types are:

- **Yield Control** (vehicles on the minor intersecting road must yield to vehicles on the major intersecting road)
- **Stop Control** (traffic on the minor road must stop prior to entering the major road)
- **Traffic Calming Control** (traffic must yield and follow established patterns of particular traffic calming device in use at the given intersection)
- **Signal Control** (all legs of the intersecting roads, at specific interval times, required to stop based on signal control)

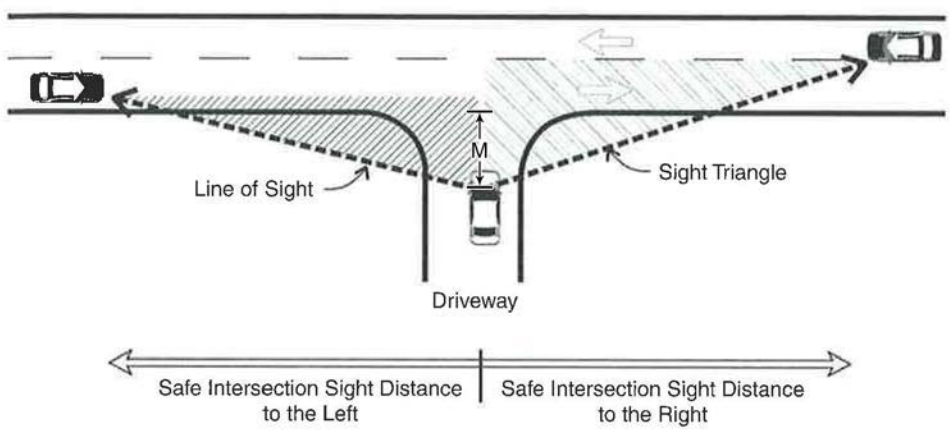
At intersections where cross traffic is controlled by a stop sign, additional stopping sight distance must be provided for the vehicles on the major road because of the conflicts between vehicles on the through road and the cross road.

Intersection sight distance is a function of (1) the type of control, (2) the length of the design vehicle, (3) the acceleration rate of the design vehicle, (4) perception and reaction time, (5) the width of pavement and in cases of divided roadways/highways the width of the median, (6) design speeds, and (7) skew angle of intersection and gradient of roadways. AASHTO's *A Policy on Geometric Design of Highways and Streets* contains a thorough discussion of intersection sight distance with accompanying tables and charts. This publication should be consulted for guidance.

<u>Table 3.2 – Sight Triangles at Intersections</u>

Sight Triangles At Intersections*			
Minor Approach			
		Street	Driveway
M	Major Arterial	L=325'	L=325'
a		R=150'	R=150'
j		M=15'	M=15'
o			
r	Minor Arterial	L=325'	L=325'
		R=150'	R=150'
		M=15'	M=15'
A			
p	Nonresidential	L=200'	L=200'
p	Collector	R=150'	R=150'
r		M=15'	M=15'
o			
a	Residential	L=200'	L=150'
c	Collector	R=150'	R=120'
h		M=15'	M=15'
	Local Street	L=175'	L=75'
		R=130'	R=55'
		M=15'	M=10'
* NOTE: The table assumes right angle intersections and driveways with the road. The figures shown are minimum distances; L=Left; R=Right; M= distance from curb line or edge of pavement to driver's eye location. Other angles may require additional sight distances. At signalized intersections in business zones, the City of Richmond may modify the distances; wire or chain-link fences may be approved by the city if visibility would not be impaired.			

Figure 3.2 – Intersection Sight Distance to Enter or Cross a Roadway from a Driveway



Sight distance is measured from the centerline of the driveway/street to the left and right of the intersection (L and R), and M is measured from the extended edge of curb to the driver's eye.

Figure 3.3 – Intersection Sight Distance to Make a left Turn from a Roadway into an Access Connection

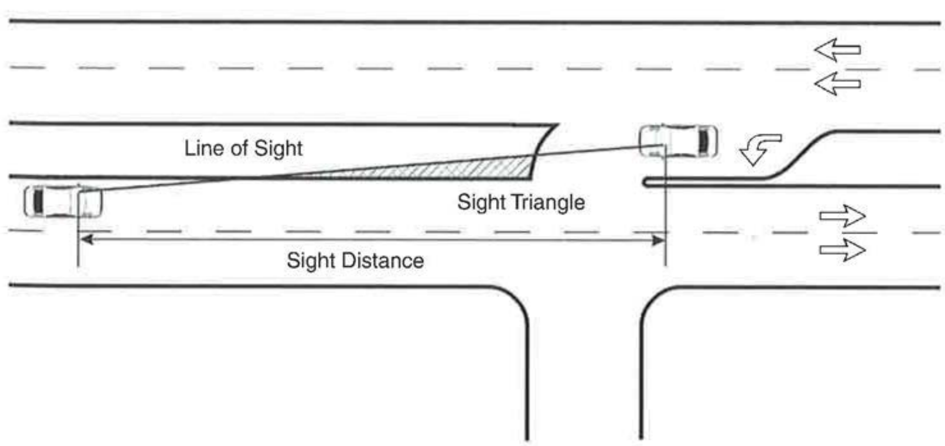
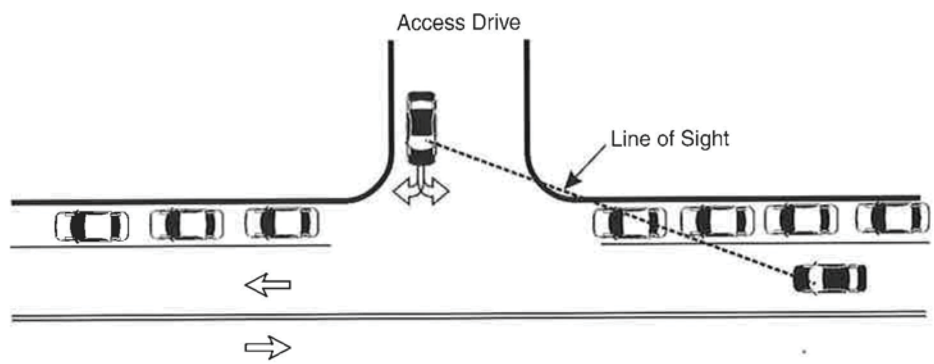
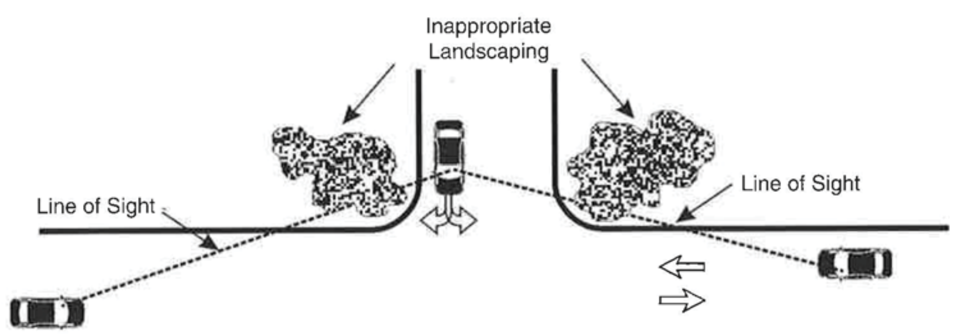


Figure 3.4 – On-street Parking Frequently Obstructs Sight Distance



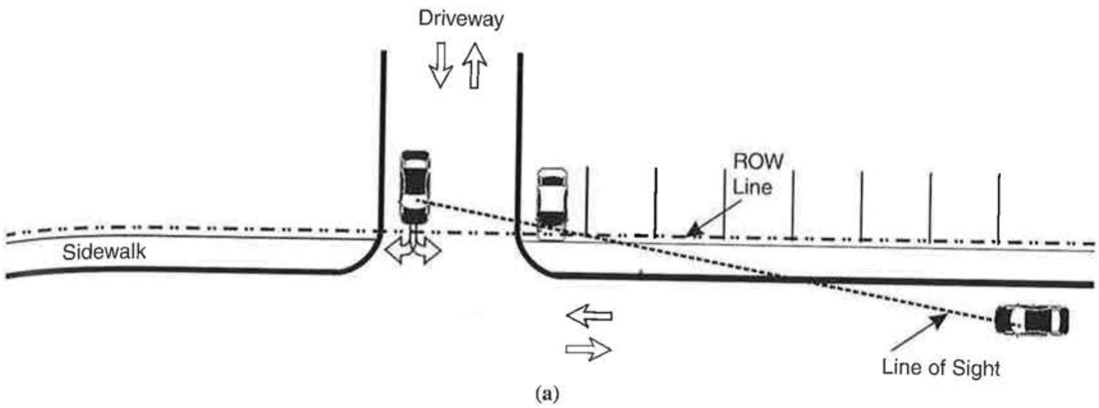
Problem: parked cars obstruct sight distance; solution: prohibit parking within the sight triangle.

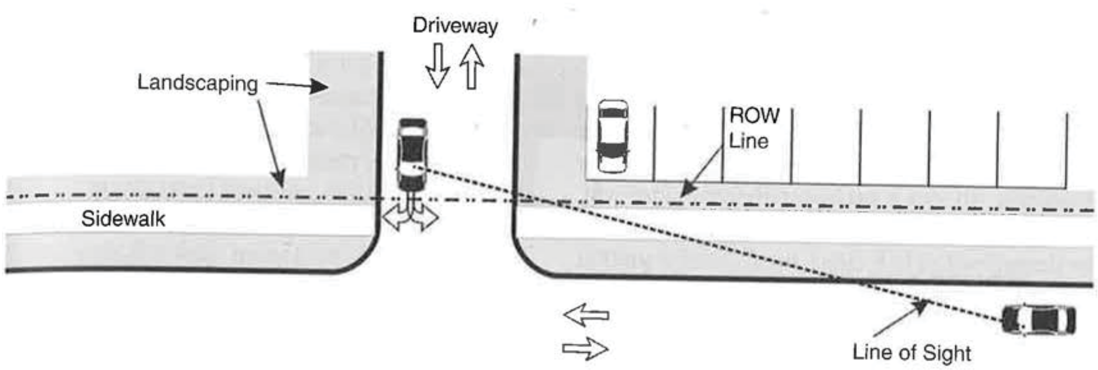
Figure 3.5 – Landscaping Obstructs Sight Distance



Problem: inappropriate landscaping or inadequate landscape maintenance obstructs sight distance; solution: restrict landscaping within the sight triangle as part of the access connection permit. Allow landscaping in compliance with an approved landscaping plan and use specified planting materials. Maintain periodic inspection.

Figure 3.6 – Parking in Close Proximity to an Access Connection



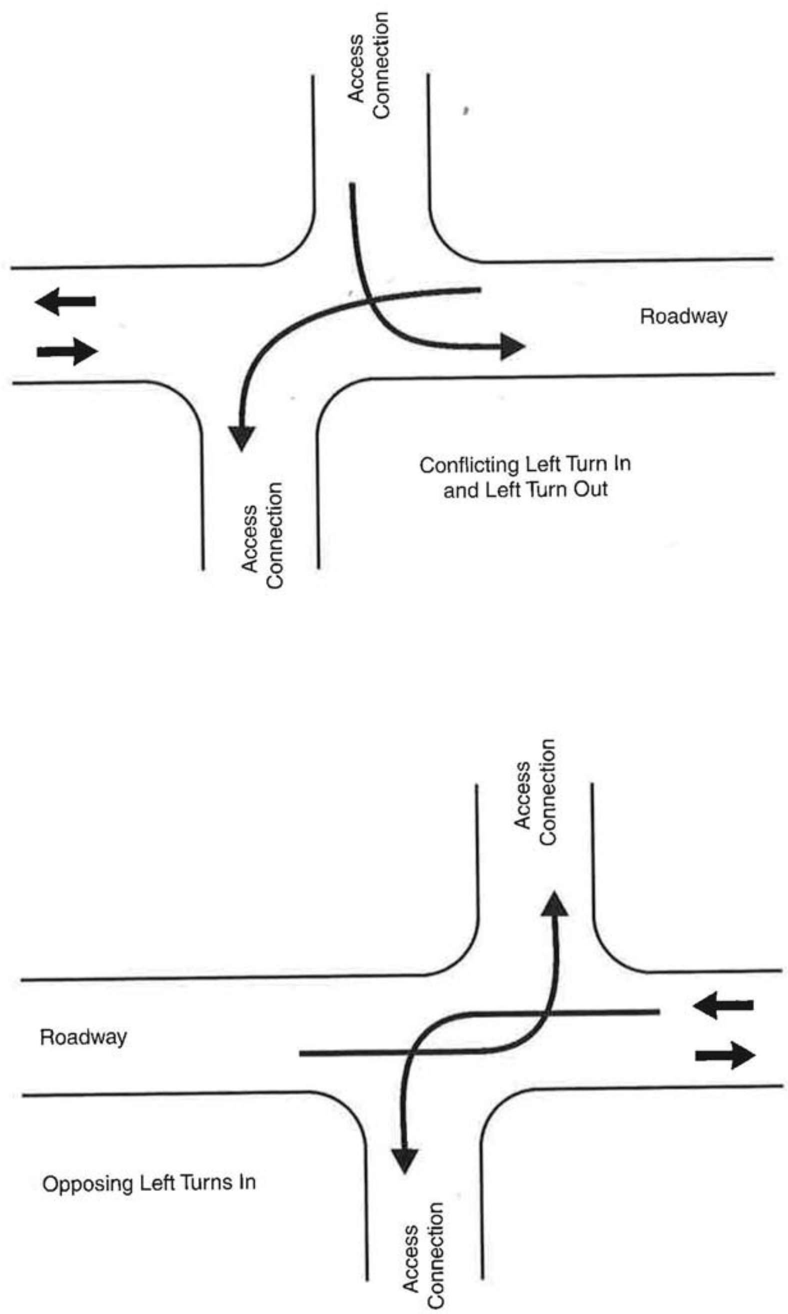


(b)

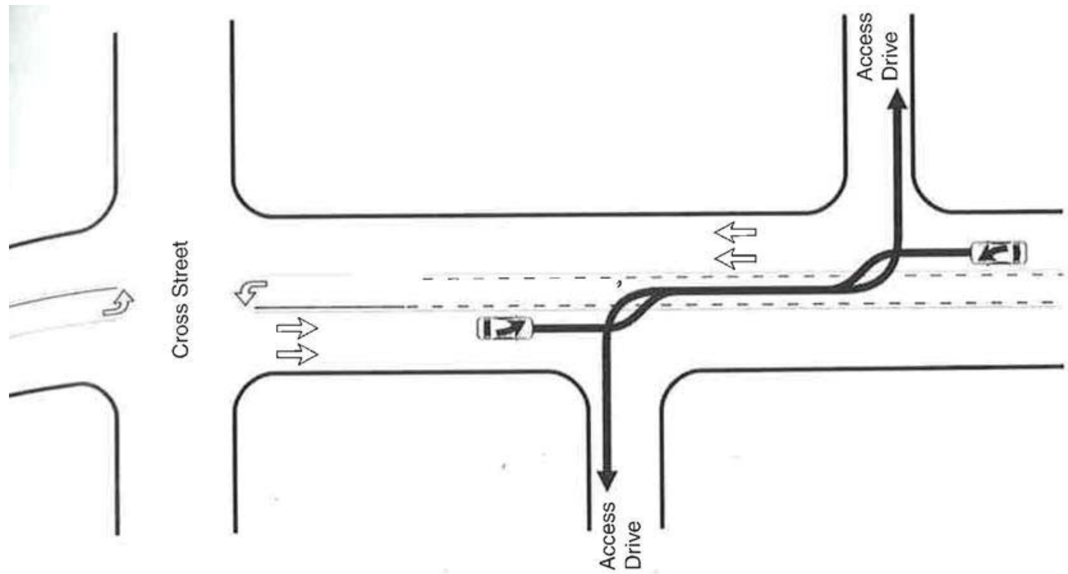
Problem: (a) parking areas are located immediately adjacent to the driveway and extending to the right-of-way (ROW) line, thereby allowing parked vehicles to obstruct the sight distance of an exiting vehicle. The problem is more severe where a van, pickup, truck or SUV is parked adjacent to the driveway.

Solution: (b) establish a landscaped buffer between the right-of-way line and a landscaped border along the access connection to eliminate parking within the sight triangle.

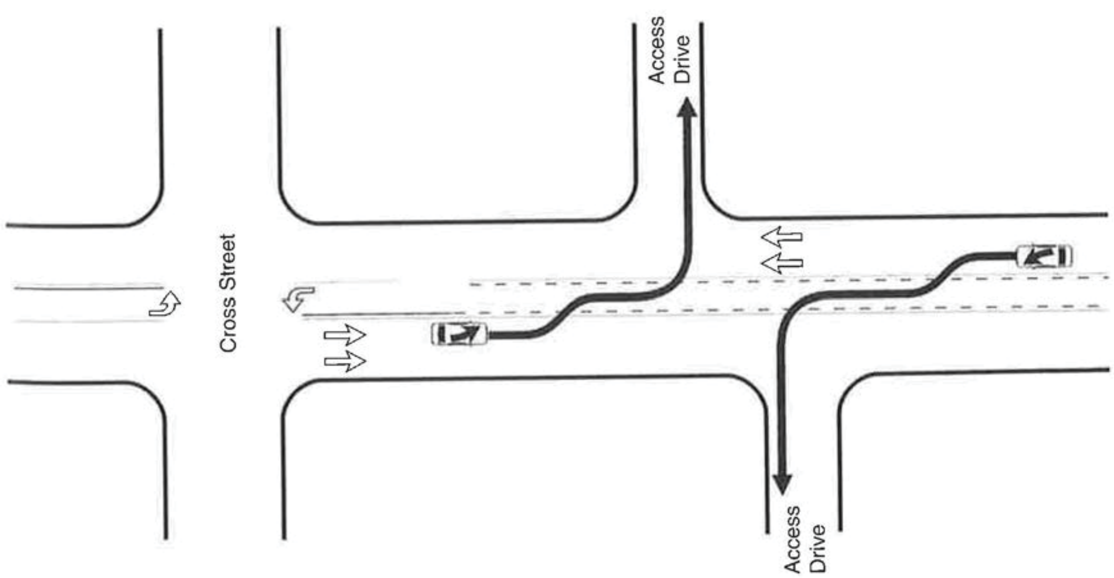
Figure 3.7 – Schematic of Problems Arising from Closely Spaced Access Connections on Opposite Sides of a Roadway



<u>Figure 3.8 –Schematic of Access Locations that Commonly Result in Overlapping Left-turn Movements</u>



<u>Figure 3-9 – Schematic of Access Locations that do not Result in Overlapping Left-turn Movements</u>



3.6 Functional Intersection Area

AASHTO Policy on Geometric Design states: "The functional area extends both upstream and downstream for the physical intersection area and includes the longitudinal limits of auxiliary lanes. The influence area associated with a driveway includes: 1) the impact length (the distance back from a driveway in which cars begin to be affected), 2) the perception-reaction distance, and 3) the car length" (2001, p. 733; 1994, p. 793; 1990, p. 841; 1984, p. 888).

Logic and analysis indicated that (a) the functional intersection area is longer than the physical intersection and (b) the upstream dimension is longer than the downstream dimension. Thus, identifying the desirable location of site access involves assessing the functional distance upstream and downstream of an intersection and ascertaining the window in which the driveway may be located.

For more detailed explanation refer to the AASHTO Policy on Geometric Design, latest edition, and the TRB Access Management Manual 2003, pp 131-135.

<u>Figure 3.10 – Physical and Functional Areas of an Intersection</u>

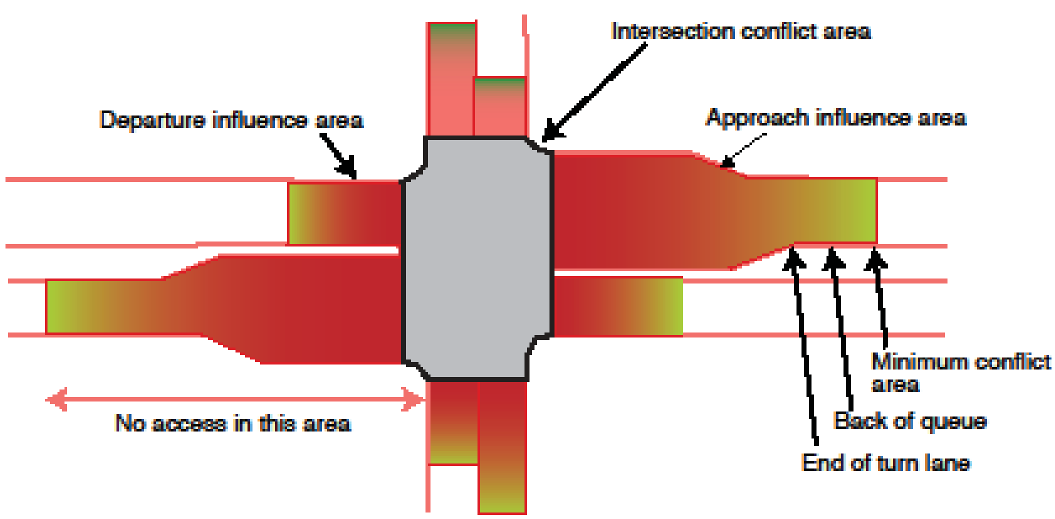


Figure 3.11 – Minimum Functional Area Length

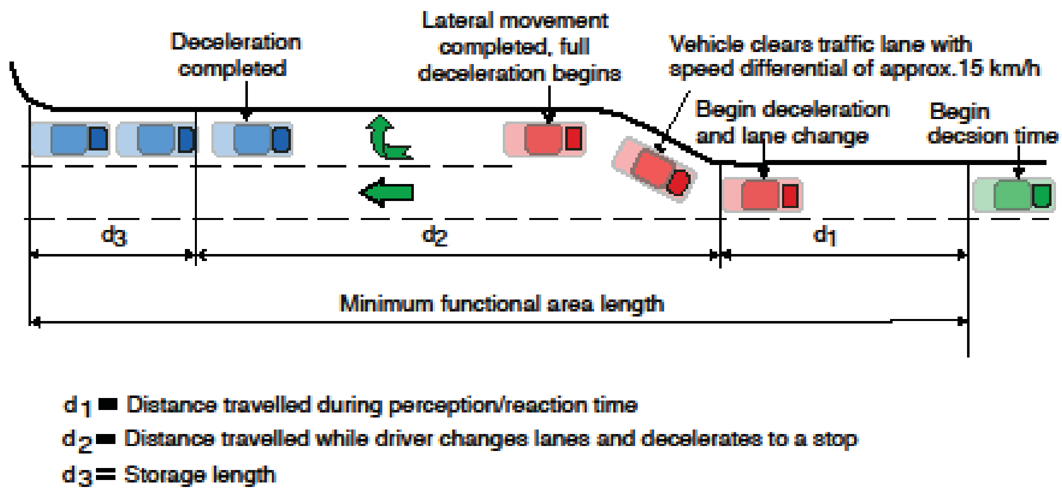


Table 3.3 – Representative Examples of Upstream Functional Intersection Distances

	Speed (mph)	Distance travelled in perception/ reaction time, d1 (ft)	Maneuver distance, d2 (ft)	Perception–reaction time, plus maneuver distances, d1+d2	Queue storage length b d3 (ft)	Note[a]	Upstream functional distance d1+d2+d3 (ft)
Rural	50	185	425	610	50	b	660
	55	200	515	715	50	b	765
	60	220	605	825	50	b	875
Suburban	30	110	160	270	375	c	645
	35	130	220	350	375	c	725
	40	145	275	420	250	d	670
	45	165	325	490	250	d	740
	50	185	425	610	125	e	735
Urban	20	45	70	115	500	f,g	615
	30	65	160	225	500	f,g	725
Source: Adapted from the TRB Access Management Manual							
a	Queue storage needs to be determined for each approach to each intersections using methods such as those discussed in the TRB Access Management Manual, chapter 10						
b	minimum storage of two automobiles or one truck						
c	Example of storage for 15 automobiles						
d	Example of storage for 10 automobiles						
e	Example of storage for 5 automobiles						
f	Example of storage for 20 automobiles						
g	Dual left-turn lanes can reduce the queue storage length						

The intersection functional area includes the area within which traffic operations are affected by the operation of the intersection including:

- All acceleration (downstream) and deceleration (upstream) lanes
- The back of the longest queue or turn lane
- Distance travelled during perception/reaction time, and stopping distance at the back of queue
- The length of any dropped lanes on the downstream side of an intersection
- Not less than the stopping sight distance to the next intersection beyond any dropped or merged lanes if present

Application

The designer must clearly show that the proposed access points do not fall within the intersection functional area of any intersection, including access points to adjacent property.

If conflicts with adjacent access points occur, the designer must show how these may be eliminated by:

- Providing alternative access
- Consolidating access to adjacent properties (with reciprocal access agreements)
- Providing turn restrictions on the access
- Eliminating or relocating the access

In the case of a corner lot, the access point(s) must be limited to one on each roadway, and must be located at the lot line furthest from the adjacent intersection. The access may be restricted to right-in and/or right-out only unless the designer can show that use by other movements will not cause operational or safety concerns. Left turns to/from an access across or from an intersection left turn lane on the street will not be permitted.

If the adjacent lot has a similarly located driveway, then the driveways must be consolidated as a single shared driveway. Provision for alternative access to a corner lot must be made. If this would require access through adjacent property, this must be identified and protected.

3.7 Access Standards by Functional Classification

The following table describes the spacing standards between functional classes of streets in Richmond.

Table 3.4 - Local Street and Driveway Spacing

	Spacing (ft)				
Road Classification	**Expressways**	**Major Arterial***	**Minor Arterial****	**Collector**	**Local Street**
Expressways	NA***	1600	1600	No	No
Major Arterial	1600	1600	1600	1600	No
Minor Arterial	1600	1600	1400	1200	No
Collector	No	1600	1200	800	400
Local	No	No	1000	400	250
* No new driveways permitted; right and left turn lanes at all intersections					
** No new residential driveway permitted, Commercial or industrial driveways shall be treated according to the non-residential spacing formula; adequate right and left turn lanes shall be determined by the City of Richmond and the KYTC					
*** Controlled by KYTC					

3.8 Spacing Measurement Definition

Distance shall be defined as the distance between the centerlines of intersecting streets and roads. However, in the case of an interchange, distances shall be measured from the centerline of any intersecting road to the closest near edge (projected) of the ramp road or in the case of a free flow ramp terminal to the gore of the nearest ramp.

3.9 At-Grade Intersection and Access Spacing Requirements

The guidelines in this manual shall be the basis for the determination of proper spacing for street intersections and driveway access. Existing development may alter conditions that will make strict adherence unfeasible. The City of Richmond shall attempt in all cases, however, to apply these guidelines to the greatest extent feasible in order to create safe and efficient traffic movement systems.

- **Types of At-Grade Intersections**

  The basic types of at-grade intersections are:

  - **T-intersections:** A point where two roads intersect, with one of these two roads terminating at this point
  - **Four-leg intersections:** The most commonly found intersections, where two roads intersect, usually at 90-degree angles, and then both roads continue after the crossing

- **Multi-leg intersection**: An intersection where more than two roads intersect, usually at unusual angles. This type of intersection is greatly discouraged.

In each particular case, the type is determined primarily by the number of intersecting legs, classification of the intersecting streets, the topography, the traffic patterns, and the desired type of operation.

- **Capacity Analysis**

The capacity analysis is one of the most important considerations in the design of intersections. Refer to the most recent edition of AASHTO's *A Policy on Geometric Design of Highways and Streets* and the *Highway Capacity Manual* for complete coverage of capacity of intersections, including procedures for making capacity computations.

3.10 Access Management Components

The primary components of Access Management include: access points (including both intersections and driveways), medians, auxiliary lanes and connectivity.

Access points, including driveways allow for ingress and egress from a roadway to abutting properties. The control of the spacing and design of driveways help to create a smooth flow of traffic and have been proven to reduce crash rates.

Medians physically separate different directions of traffic flow. The proper design of medians controls the movements to and from the through road to a side street or driveway. The management of median openings facilitates a smoother flow of traffic, a separation of opposing traffic and channelizes traffic to traffic signals. Properly designed and spaced medians have also been proven to reduce crash rates, especially the more serious head on and angle crashes.

Auxiliary lanes are incorporated into access management designs to facilitate the flow of traffic near and at driveways and median openings. Auxiliary lanes, including left and right deceleration lanes, allow traffic exiting the through lanes an area to decelerate and be safely stored with minimal effects to the through traffic. Acceleration lanes allow traffic entering the through traffic to merge with minimal disruption to the through traffic.

Connectivity allows traffic to progress from local roads up the functional class hierarchy, to arterials and freeway roads. This progression reduces the "cut through" traffic on local roads and provides the proper balance of access. Connectivity between abutting properties reduces the trips on the through road thus eliminating additional conflict points and congestion.

Chapter 4
Access Points, Driveways

4.1 Introduction

Access point and driveway design, location and spacing are fundamental to the success of access management. The term access point and driveway will be used interchangeably in this document, but the terms are referring to both features.

The benefits of access management provide safer and more efficient use of the roadways and access to private developments, even though regulating driveway spacing and design may restrict direct driveway access to some properties. Proper design practices will reduce the number of conflict points encountered by all motorists, thus enhancing the safety of the roadway for all users. In addition, driveways and turning lanes must be designed so that they are capable of handling the amount of traffic expected to use them. The proper design of driveways encourages a smooth flow of traffic to and from connecting properties. If a driveway is not designed properly, traffic on the through road may have to slow down considerably, stop, or swerve into another lane to avoid a turning vehicle. This greatly reduces capacity and causes safety concerns.

4.2 Access Point Characteristics

Access points can be roadways or driveways. The principles of access management are similar to both public and private streets and access points. The following practices and principles apply to both types.

4.3 Residential and Commercial Driveways

There are two major types of driveways, residential and commercial.

Residential driveways serve low volume single family or duplex parcels. Residential parcels with three or more units, apartment complexes, condominium developments, as well as all other developments that are accessed through a common private drive or street system, shall be treated as Minor/Major Commercial Driveways depending on the size of the development.

- Residential Driveways
    - All single-family residential structures shall be allowed one access per lot. An additional point of access may be permitted for corner lots, loop driveways, or other instances where public safety will not be impaired by utilizing a second point of access. Duplexes may be permitted two accesses if the city deems it necessary. Residential subdivisions

shall be designed such that these uses have no direct driveway to either principal or minor arterials.

- All residential accesses shall be at least 25 feet away from the right of way line of any public or private local street intersection, and at least 50' away from the right of way line of any public or private collector street intersection. High density private driveways should not intersect local streets.

- Driveways shall not be constructed within the curb return of a street intersection.

- **Commercial Driveways**

  - All new commercial driveways shall have access to major arterial streets via service roads only. Commercial driveways may have access to minor arterials and collector streets. Commercial driveways shall generally not have access to residential local streets.

  - Commercial driveways can be subdivided into three categories,

    - major commercial - A major commercial driveway is any driveway in which the actual or anticipated traffic volume is 500 or more vehicles entering and leaving during a 24-hour period. Typical major commercial drives serve large shopping malls, big box stores, strip shopping centers, restaurants, etc.

    - minor commercial - Minor commercial driveways are driveways that carry actual or anticipated traffic volumes less than those for a major commercial driveway. These driveways typically serve small professional office buildings, small medical offices, small commercial shopping centers, individual commercial lots and small or individual apartment buildings.

    - industrial - Industrial driveways should be reviewed as a commercial drive with emphasis on the heavy truck traffic associated with the site. Larger radii, lane width, throat length and storage queues may be necessary.

  - The spacing of these accesses shall be measured from the right-of-way line of the nearest intersecting street or the centerline of the nearest intersecting non-residential access point (i.e., driveway).

  - The minimum spacing on commercial access points shall be based upon the maximum potential trip generation of the contiguous area which has been zoned and/or planned for commercial land use that abuts the subject road facility and encompasses the area which has been proposed for development by the developer. Access to a minor arterial via a service road shall be allowed only in accordance with the spacing standards based upon the trip generation of the total area immediately served by the service road. The determination of potential trip generation shall be made using sources and methods consistent with the Institute of Transportation Engineers and approved by the City of Richmond. The spacing of access points shall be determined as follows: D = 1400 - (1000 (1 - TE/3000))

Where:

- D = the required distance between access points (in feet).
- TE = the maximum potential trip ends of the area in which the development will take place.
- If D exceeds 1,400 feet, then the minimum standard of 1,400 feet shall apply to all access points of that development. D shall be rounded to the nearest 50 feet. For properties fronting along street facilities where the required spacing would not allow an individual access to properties adjacent to the property currently being developed, an arrangement shall be made for the joint use of entrances or the construction of service roads by developers.

- Head-in, back-out parking is prohibited for all commercial driveways on all streets
- Driveways shall not be constructed within the curb return of a street intersection.

4.4 Criteria to Review Driveway Location

The primary information needed to begin review of a new driveway connection is

- The development type,
- The type of road the driveway is connecting to,
- The trip generation,
- The type of vehicles entering and the adjacent property use.

It is essential that the reviewer have information regarding the existing conditions of the roadway such as the presence of curb, gutter, sidewalk, etc. For single-family residential access onto a residential street, a typical 12-foot drop curb driveway is a sufficient design. If sidewalk is present, a concrete drive entrance that meets the City's standards shall be used. An industrial site generating 1,500 trips a day with 15% truck traffic on an arterial road will require a review of acceleration/deceleration lanes, a wider driveway for the truck turning radius among other safety and efficiency considerations.

4.5 Shared Use Driveways

Shared use driveways should be encouraged where possible to reduce the number of existing driveways. If shared use access is not feasible under existing conditions, a stub out should be included in permits for possible future cross access agreements between adjacent parcels of property. Shared access should only be considered for similar land uses. If adjacent land uses promote the success of a shared use driveway they should be incorporated. Success of shared access driveways partially depends upon sufficient throat depth for drivers to access their choice of destination after entering the drive and site plans should be laid out to encourage these drives. Such elements of site design can be determined with a thorough traffic impact study.

Shared use driveways may be approved provided that a permanent written access easement is obtained. The developer must include a plat note and provide dedication documents indicating that maintenance of the shared use driveway shall be the responsibility of the lot owners served by the shared use driveway. If more than three (3) residences are to be served by a single shared use driveway, the following requirements apply:

- The developer must post fiscal surety for the construction of the shared use driveway prior to plat approval and must construct the driveway during the construction of the streets within the same subdivision, or within the term of the fiscal instrument if no public or private streets are to be constructed within the subdivision. The driveway construction shall be subject to City inspection and obtain City approval before fiscal surety will be released. See section 516 of the Development Ordinance (DO) for surety requirements.

- The developer must construct a driveway, designed by a professional engineer, to have an all-weather surface and a pavement structure meeting at least private street standards.

4.6 Divided Drives That Permit One Way Traffic, Signs and/or Landscaping.

Divided driveways should be designed in a manner that does not promote wrong way movements, hinder sight distance or divert attention away from driving. Driveway medians shall be located a sufficient distance from the main roadway to allow for all turning movements anticipated into and out of the site. In addition, lanes should be sufficiently wide to prevent damage to curbs and shoulders at these access points.

One-way driveways shall be prohibited on two-way undivided streets unless approved by Planning and Zoning. One-way driveways are limited to developments where two-way access is unfeasible because of special design considerations, such as severe site constraints, the need for circular drop-offs or other circumstances where one-way circulation may be preferred to two-way access. Examples of such developments include public and private schools, day care uses, car wash facilities and existing developments or small sites where two-way circulation is impractical.

Developments shall be designed to promote one-way, on-site circulation in support of the one-way drives. Circular drop-offs and one-way driveways shall be designed to prevent conflicts with traffic access, parking and on-site circulation. All one-way driveways separated by more than 15 feet (measured from edge to edge) must be signed for one-way operation.

4.7 Access Points Per Parcel of Land

Each existing tract of land is entitled to one direct or indirect access point to the public roadway network provided that its location and design fulfill, as a minimum,

- The requirements of minimum corner clearance,
- Minimum sight distance, and
- Alternative shared access agreements could not be coordinated.

Vehicular access to or from property adjoining a public street shall be provided to the general street system, unless a public authority has acquired such access. The provisions of this document shall not be deemed to deny reasonable access to the general street system.

4.8 Driveway Application Map Requirements

A site plan/plot plan showing all existing right of way, easements, curbs, storms drain inlets, flumes, underground and overhead utilities, median cuts, adjacent driveways, sidewalks, or other potential obstructions shall be required for each non-residential driveway permit applications.

If the subject property is along a road with a raised median and there is no median opening servicing the property, i.e., within 150 feet of the property lines, the driveways and roadway characteristics on the opposite side of the median shall not be required to be shown on the permit request.

4.9 Maneuvering Into or Out of Driveway

All vehicle maneuvers on large apartment complexes, commercial and industrial properties into a parking space or up to a loading dock or into any other area shall be accomplished by off street maneuvering areas and internal driveways. Back-in or back-out vehicle maneuvering is permitted from residential drives on local and collector streets only.

4.10 All Driveway Components Shall Stay on Parcel Frontage

For any driveway, the point of radius return tangency with the street curb shall not extend within five (5) feet of the property line (projected perpendicular to the street centerline), except as provided in shared driveway agreements and as approved by the City of Richmond.

4.11 Distance of Driveway from Obstruction

Driveways shall not be located closer than four feet (4’) to any fire hydrant, electrical pole, any other surface public utility or other obstruction.

Applicant may have the surface utility moved if the public utility agency, or other private entity, involved determines that the move will not detrimentally affect the service. Such relocation will be at the developer’s expense.

4.12 Distance of Driveway from Drainage Inlet

The driveway curb return shall be designed so as to not interfere with or affect the nearby drainage inlets. Driveways shall be located 5 to 10 feet away from any drainage inlet, depending on the type of traffic using the driveway, to eliminate damage to the structure from turning vehicles overrunning the edge of the driveway.

4.13 Location of driveways on Opposite Sides of Streets

Major access points on opposite sides of collector and arterial roadways shall be located opposite each other. Turning movement or driveway location restrictions may be imposed as determined necessary by Planning and Zoning if such orientation is not possible.

Commercial driveways on undivided minor arterial streets shall be designed to align with opposing streets or driveways or be offset by a minimum of 200 feet (measured from edge to edge). All commercial driveways on undivided collector streets shall be designed to align with opposing streets or driveways or be offset by a minimum of 150 feet (measured from edge to edge). All commercial driveways on divided streets shall be designed to align with median breaks or be offset by a minimum of 125 feet (measured from the nose of the median to the nearest edge of the driveway). Alignment of driveways with opposing streets is discouraged for signalized intersections. If such alignment is appropriate, the driveway approach may be constructed without an apron and the maximum driveway widths may be increased to match the cross-section of the opposing street if such design is approved by the City of Richmond. The developer shall be required to pay for any modifications to the driveway entrance and signal installation to accommodate the new driveway.

It is desirable to minimize the number of driveways on an arterial street in order to reduce the number of conflict points and facilitate traffic flow. The dimension for spacing between driveways should be increased whenever possible so that the number of driveways can be reduced. It is recognized, however, that certain existing tracts may not be able to fully comply with these standards due to limited frontage or other constraints. When compliance with this manual is precluded due to the location of driveways on adjoining properties, attempts should be made to obtain alternative access where feasible, including shared access driveways, access easements to adjoining properties or access to intersecting streets.

4.14 Temporary Access Points

Any access point that does not comply with this manual may be designated as "Temporary" upon approval by the City of Richmond.
In all cases where said access points are classified as "temporary", such designation shall be duly noted on the plot plan or site plan submitted for approval. When a property served by a temporary access point is provided an alternative means of access, such as a connection to a frontage road, on an intersecting street, or a shared use driveway, the City of Richmond will require that the temporary access be eliminated, altered, or limited to certain turning movements.

4.15 Non Conformance Driveway

When an application for building permit or change in property use results in changes in the type of driveway operation and the driveway is not in conformance with this manual, the reconstruction, relocation or conformance of the access to this manual will be required, at the owner's expense.

The City of Richmond may require driveway revisions if one or both of the following access change conditions have occurred:

- The existing use of the driveway is projected to increase in actual or proposed daily vehicular volume on the driveway by twenty percent (20%) or more. This determination shall be made by Planning and Zoning using generally accepted transportation engineering standards.

- The change in the use of the property or modifications to the property restricts the flow of vehicles entering the property in a manner, which is anticipated to disrupt normal traffic flow on the public street, thereby creating a hazard.

"Change in property use" may include but is not necessarily limited to: change in type of business; expansion in existing business; change in zoning; combining parcels of land; and the subdividing of land, which creates new parcels. It does not include modifications such as advertising, landscaping, minor remodeling, general maintenance or aesthetics that do not affect internal or external traffic flow or safety.

4.16 Traffic Impact Study

The city of Richmond shall require the developer to provide a Traffic Impact Study if it deems that any of the following conditions are met. The study shall also identify any improvements to existing infrastructure that must be made to accommodate the development:

- During review of proposed development plans that future traffic generated from such development will adversely affect the capacity of the roadway

- Residential developments of 50 or more units and multifamily developments of 40 or more units
- Proposed development is located along existing roadways that are not compliant with the current standards

- Proposed development along a road where location, size and number of driveways, restriction or channelization of turning movements, or other improvements related to access affect the capacity of the adjacent roadway

- All county roads that are not compliant with this manual when an application is filed to annex or develop the property accessed by such county road.

4.17 Proposed Driveways within Queuing Lanes

Any proposed driveway within a queuing lane on adjacent roadways will be prohibited.

4.18 Driveway Design Elements

- The <u>angle</u> of a driveway is measured between the highway centerline and the driveway centerline measured in a clockwise direction. In all cases the angle of driveway intersection to the right of way line shall be 90%. The City of Richmond may alter the angle in cases of one way driveways, sight or building obstructions, other site constraints or other conditions that do not affect the safety of the driveway with respect to bicycles or pedestrian movements across the driveway.

- <u>Driveway grade</u> is another important driveway design element. The driveway grade is the slope of the driveway (positive or negative). Along with the slope of the driveway, the differential between the grade of the roadway shoulder or sidewalk portion of the roadway corridor and the grade of the driveway should be reviewed. This differential should be minimized to help traffic ingress and egress from the site.

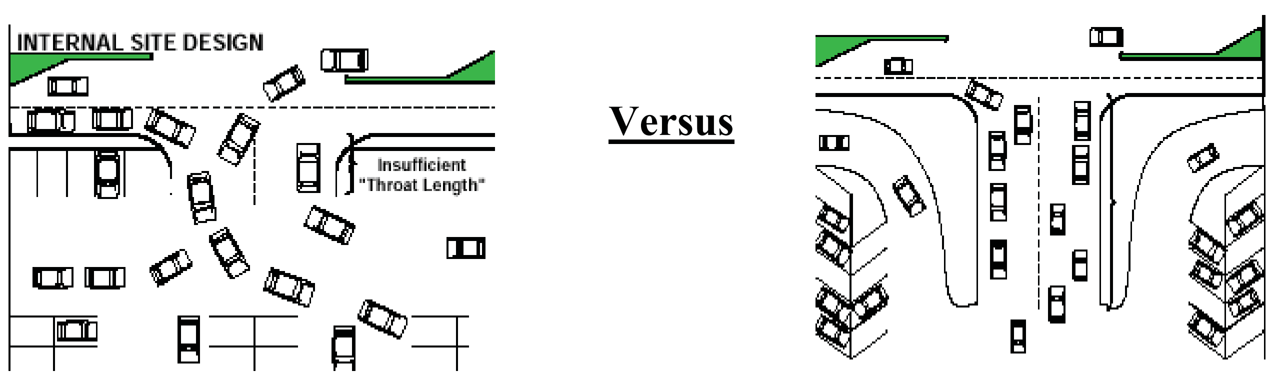
- Driveway throat length is the distance between the street and the parking lot served by a driveway. As shown in the figure, insufficient throat length can create confusion and cause vehicles to become "stuck" in unsafe areas. This is shown in Figure 4.1. An adequate throat length helps to keep traffic conflicts within a parking lot to an acceptable level and provides space on the driveway for incoming and outbound traffic. The following throat length guidelines are suggested:

    - For low traffic volume commercial and industrial driveways (below 100 peak hour vehicles in both directions), the shortest desirable driveway throat length is 25 ft.

    - For medium traffic volume commercial and industrial driveways (150 – 400 peak hour vehicles in both directions), the shortest desirable driveway throat length is 80 ft.

    - For high-volume driveways (over 400 peak hour vehicles in both directions) such as a shopping center entrance, the adequate throat length is to be determined by the results of a traffic study.

Figure 4.1 – Throat Length



The throat lengths above may be adjusted, if Planning and Zoning determines that one of the following conditions requires an increased distance. The developer can also be required to perform a traffic impact study for Planning and Zoning to review for a determination of the proper distance. The factors to be considered include:

1. Physical constraints on the site, such as existing structures;

2. The impact upon on-site circulation;

3. Shallow lot depths or unusual lot configurations;
4. Existing or potential traffic movements that have an adverse effect on operations;
5. Traffic volumes and classification on the driveway and the intersecting street;
6. For existing sites, the extent of redevelopment proposed.

- Gated entrances should have sufficient throat depth that during the peak hour traffic will not back out into the road while they wait for the gate to open.

- One of the fundamental design elements of a driveway is to include a radius return or a drop curb/flare. A radius return describes a situation in which the curb and gutter or shoulder follows a radius to ingress and egress the site. A drop curb/flare is defined as a typical urban driveway where the sidewalk, if present, and curb and gutter are dropped to meet the roadway and then transitioned back to the normal height. A radius return requires more right of way but it guides the driver and also provides a smoother transition. A drop curb requires little right of way and is easier to construct; however, since drivers must reduce their speed to turn, through traffic is slowed down.

- The City of Richmond has standard driveway widths to help create a safe, smooth transition between roadways and private property. Wider driveways may introduce conflicting movements and/or hinder sight distance. In addition, wider driveways increase the distance a pedestrian has to travel to cross the entrance thus creating a riskier crossing situation. Also, if the wide drive has a very wide landscaped median, drivers may think that each drive is a two-way access point, which introduces the potential for head on collisions.

- Minimum driveway spacing is critical to minimize the potential for accidents and delay to through vehicles. All adjacent driveways must be separated by the minimum driveway spacing of 10 feet, measured from near edge to near edge of adjacent driveways.

- The location of driveways adjacent to intersecting streets shall conform to the minimum corner clearances. Corner clearance is the distance from an intersection to the first intersection or driveway, measured from near edge to near edge. This helps to ensure the major intersections' functional areas are not degraded by the introduction of additional conflict points. Corner clearance values are dependent upon the roadway classification. Should two streets with differing classifications intersect; the minimum corner clearance for the higher classified street will apply along each leg of the intersection.

- All driveways and intersecting roadways shall be designed and located so that the minimum sight distances are met. Driveways may be prohibited where adequate sight distance is not available for the established speed limit or the design speed of a future street improvement, if higher. If an inspection by the City of Richmond indicates that driveway sight distance may be insufficient, the applicant will be required to submit vertical and horizontal information to the City that verifies adequate sight distance is available for the proposed driveway location. The city may deny access or a specific driveway location to any abutting public street if said access cannot be provided in a reasonable and safe manner.

4.19 Driveway Grades

- **Sidewalk Slopes -** Sidewalks shall slope down at a (running) grade not more than 12:1, and shall comply with all Americans with Disabilities Act (ADA), as amended, requirements, to meet the elevation of the driveway unless the City approves a method that will provide acceptable use by handicapped users.

  In addition, the cross slope of the sidewalk shall not exceed 2% (1/4” per foot) through the entire width of the drive entrance.

- **Positive Grade -** Any driveway approach shall have an initial positive grade when curb, gutter, and sidewalk are present.

  The initial approach shall extend onto private property if necessary, but driveways shall not be constructed at locations or in such manner that water is diverted from the street onto private property.

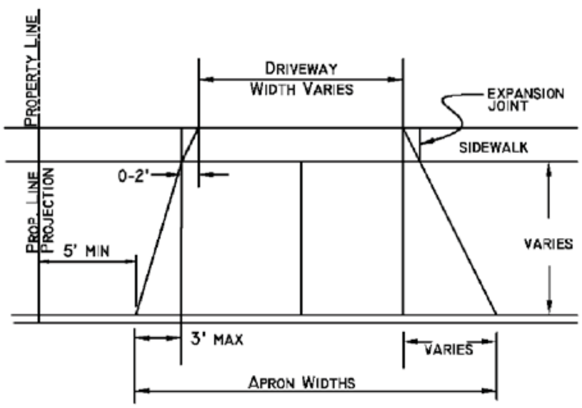
- **Maximum grades for driveway entrances are necessary to ensure vehicles’ ease of access to and from roadways -** Average drive slope shall not exceed a twelve percent (12%) up slope or five percent (5%) down slope within 10 feet of back of sidewalk when present. The average drive slope shall not exceed a ten percent (10%) up slope or twelve percent (12%) down slope within 15 feet of back of curb or edge of pavement when no sidewalk is present or required. Any sidewalk affected by driveway approach construction shall be modified to adequately address handicap (ADA) issues and transition at no greater than 12:1 down to the driveway. Driveway grades and other design standards are shown in the drive entrance detail in Figure 4.2 – Driveway Apron Geometry.

- **Driveway Grade Breaks -** Where a driveway crosses or adjoins a sidewalk, walkway, or an accessible path of travel (as defined by the Americans With Disabilities Act of 1990) the driveway grade shall be a maximum of two (2) percent, over a minimum throat length of three (3) feet contiguous with the sidewalk, thereby effectively matching the cross slope of the sidewalk or accessible path of travel across the full width of the driveway.

Figure 4.2 – Driveway Apron Geometry

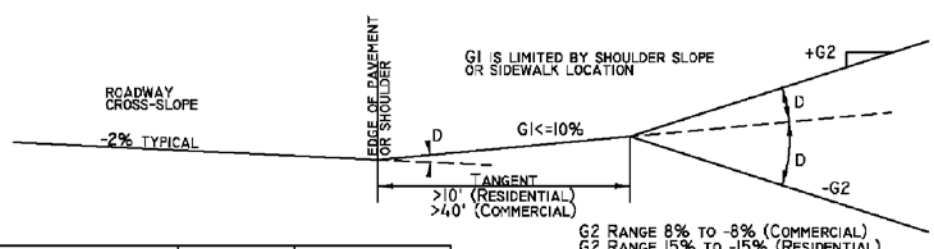
APRON GEOMETRY

SEE DIVISION OF ENGINEERING, ENTRANCE DETAILS (STANDARD DRAWINGS-ATTACHED)



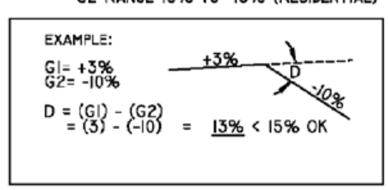
CLASSIFICATION	DRIVEWAY	STANDARD APRON	ALTERNATE APRON
SINGLE RESIDENTIAL	12'	3' STRAIGHT FLARE = 18' CURB CUT	—
DOUBLE OR JOINT RESIDENTIAL	20'	3' STRAIGHT FLARE = 26' CURB CUT	—
NONRESIDENTIAL	30'	5' STRAIGHT FLARE = 40' CURB CUT	10' RADIAL FLARE = 50' CURB CUT
COMMERCIAL LOADING	30'	15' STRAIGHT FLARE = 60' CURB CUT	20' RADIAL FLARE = 70' CURB CUT
INDUSTRIAL	40'	20' STRAIGHT FLARE = 80' CURB CUT	25' RADIAL FLARE = 90' CURB CUT

VERTICAL ALIGNMENT



TYPE	DESIRABLE (D)	MAXIMUM (D)
HIGH VOLUME DRIVEWAY	0%	+/- 3%
LOW VOLUME DRIVEWAY ON MAJOR OR COLLECTOR STREETS	+/- 3%	+/- 6%
LOW VOLUME DRIVEWAY ON LOCAL STREETS	+/- 6%	+/- 15% CONTROLLED BY VEHICLE CLEARANCE

*IF A GRADE CHANGE GREATER THAN 15% IS NECESSARY, AT LEAST A 10' VERTICAL CURVE MUST BE USED TO TRANSITION BETWEEN SLOPES.



ENTRANCES AND ACCESS CONSIDERATIONS

Chapter 5
Medians

5.0 Median Treatments

5.1 Introduction

Left turns generate more than two-thirds of all access-related collisions. Where left turns are made from a through lane, virtually all through vehicles in the shared lane are blocked by the left-turning vehicles.

The presence or absence of a median has a substantial impact on roadway operations and safety, and on the provision of left-turn access to abutting properties.

Medians should be included on all arterial roads where there is adequate right of way. On major collector roads, medians should be seriously considered for inclusion for future projects. For minor collector and local roads, medians should be included where their benefits are greater than their costs or for aesthetic purposes.

5.2 Median Types

Median types can be grouped as follows;

- **Traversable median** - a median that by its design does not physically discourage or prevent vehicles from entering upon or crossing over it, including painted medians;
    - A traversable median does not provide positive control over left turns. Because it is not effective as an access management tool, it is not discussed further.

- **Continuous two-way left –turn lane (CTWLTL)** – a continuous lane located between opposing traffic streams that provides a refuge area for vehicles to complete left turns form both directions;
    - Reduced crash rates compared to undivided roadways
    - Increases capacity compared to undivided roadways
    - Reduces delay compared to undivided roadways
    - No safety benefits compared to nontraversable medians
    - No pedestrian refuge areas, increasing pedestrian conflicts
    - Overlapping left-turn movements that cause safety issues
    - Accommodates strip development, but does not discourage it

- **Nontraversable median** – a physical barrier in the roadway that separates traffic traveling in opposite directions, such as a concrete barrier or landscaped island.

    - Physically separates vehicles traveling in opposite directions, reducing head-on collisions
    - Clearly define left turn opportunities
    - Provides a space for vehicle decelerations lanes
    - Provides a refuge for drivers crossing the major roadway
    - Number of conflicts with pedestrian and bicycles is reduced
    - A refuge for pedestrians can be provided
    - Less delay to through vehicles compared with TWLTL
    - Nontraversable medians are safer than roads with a TWLTL for both vehicles and pedestrians

5.3 Selecting a Median Type

The basic choices for median type and design are:

- Install a TWLTL on a new or existing undivided roadway
- Install a nontraversable median on a new or existing undivided roadway
- Replace a TWLTL with a nontraversable median

Factors to consider include:

- Functional classification of road
- Projected traffic volume
- Presence of pedestrians crossing the roadway
- Desired or existing development pattern of abutting properties
- Existing or proposed supporting roadway system
- Visual quality of the roadway corridor
- Crash experience
- Ability to accommodate left turns by providing opportunities for u-turns or rerouting traffic over a supporting circulation system
- Availability of funds for reconstructed and, if needed, additional right of way
- Community support

Use of a TWLTL

TWLTL may be appropriate for the following roadways:

- Roadways in urban and suburban areas with a projected average daily traffic (ADT) of less than 24,000 vehicles per day

- Collector streets in developing residential areas where residences front on local streets that

intersect with the collector street
- Collector streets in developing suburban areas where direct access is to be provided to small abutting properties
- Collector streets in developed urban and suburban areas where there is no crash pattern that is correctable by a raised median.

Use of a Nontraversable Median

A nontraversable median is more desirable than a TWLTL for the following situations:

- all new multilane urban arterial roadways
- existing multilane urban arterials roadways with ADT greater than 24,000
- rural multilane roadways
- bypass of an urban area
- roadways where aesthetic considerations are a high priority
- multilane roadways with a high level of pedestrian activity
- high crash locations or areas where it is desirable to limit left turns to improve safety

5.4 Existing Median Treatment Guidelines

Existing medians that do not meet current recommended practices should be retrofitted to comply. If private development projects are proposed, their proposed plans shall comply with the standards to the maximum extent practicable.

Improving existing median conditions may include removal of median openings, reducing the length of wide median openings, redesign to permit only specific movements, adding left turn lanes, widening a narrow median to provide safe vehicle storage or pedestrian safety, reviewing the operation of a Two Way Left Turn Lane or adding auxiliary lanes. Left turn lanes will greatly increase the safety associated with any median retrofit project. By adding a safe area for cars to decelerate, stop and safely be stored before making a left turn, the probability of rear end accidents is greatly reduced. These lanes also help the through traffic to maintain a free flow speed.

5.5 Signalized Access Point Median Treatment

Access points shall be designed such that those which will warrant signalization shall be spaced according to street access standards. The location and design of the signalized access points shall be determined by a traffic engineering study prepared by a qualified traffic engineer at the developer’s expense. This study shall be subject to the approval of the City of Richmond (if on a state highway, with additional approval of the KYTC) and shall account for at least the following variables:

- Traffic signal phasing as determined by analysis of projected turning movements;

- Traffic signal cycle length as determined by analysis of projected traffic volumes;
- Relationship to adjacent signals (existing or proposed) for purposed of signal interconnection and coordination;
- Roadway geometrics and sight distance considerations; and
- Accident experience.

If the installation or modification of a traffic signal is approved, the developer will be required to pay for all costs to design, purchase, and install the signal equipment. The City of Richmond will operate the equipment upon dedication to the city.

5.6 Median Width

Median width is dependent on a variety of conditions, including right of way available, pedestrian presence, or the volume of turning movements expected, or an aesthetic treatment of the surrounding area. The following figure shows a comparison of width that might be used for medians; however, use of wider medians for aesthetic purposes can result in median widths much greater than what is shown.

Figure 5.1 - Median Widths

	Median Widths	
Median Function	**Minimum Width (ft)**	**Desirable Width (ft)**
Separation of opposing traffic streams	4	10
Pedestrian refuge and room for signs and appurtenances	6	14
Storage of left-turning vehicles		
Single left-turn bay	14	18
Dual left-turn bay	25	30
Protection for passenger vehicles crossing or turning left onto the mainline	25	30
Design directional openings for selected ingress or egress movements only	18	30

5.7 U-Turns

A nontraversable median limits left turns and crossing maneuvers to those locations where a median opening is provided. Additionally, unsignalized median openings may permit only particular movements, such as u-turns. Florida, Colorado and Michigan utilize this tool frequently on major arterials. The provision of exclusive u-turn lanes in medians can increase the distance between signalized intersections, increasing efficiency in the traffic stream.

The use of unsignalized median opening spacing to provide for left-turn/U-turn maneuvers between signalized intersections is another tool that can be used to improve capacity at the signalized intersection. They provide convenient access to abutting properties and reduce U-turns and left turns at the signalized intersections. A more detailed explanation of the use of unsignalized median openings is found in the TRB Access Management Manual, chapter 11.

5.8 Directional Median Openings

Directional median openings allow for left turns from the major road but preclude left turns from the intersecting road or driveway. Other directional median openings allow for left turns into an intersecting road or driveway and/or out of the driveway.

Overlapping noses on directional median openings can help discourage wrong way movements. Other design elements to be considered with medians are proper sign placement and sight distance. A minimum of 25 feet of separator overlap is recommended. Figures 5.2 and 5.3 depict examples of a properly designed directional median opening.

Figure 5.2 – Schematic of a Directional Median Opening

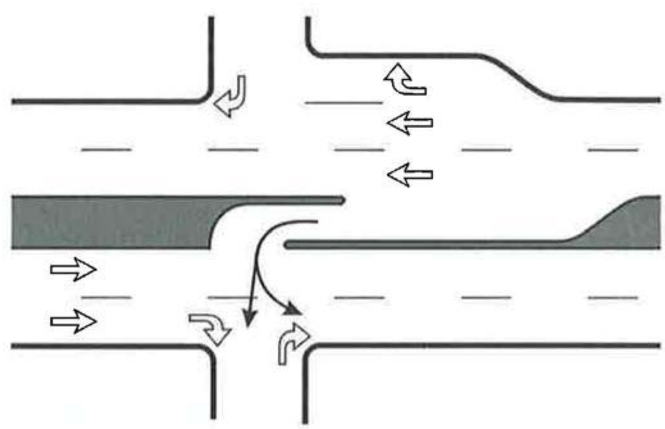


Figure 5.3 – Separator Overlap at an Unsignalized median Opening for Left-turns/U-turns

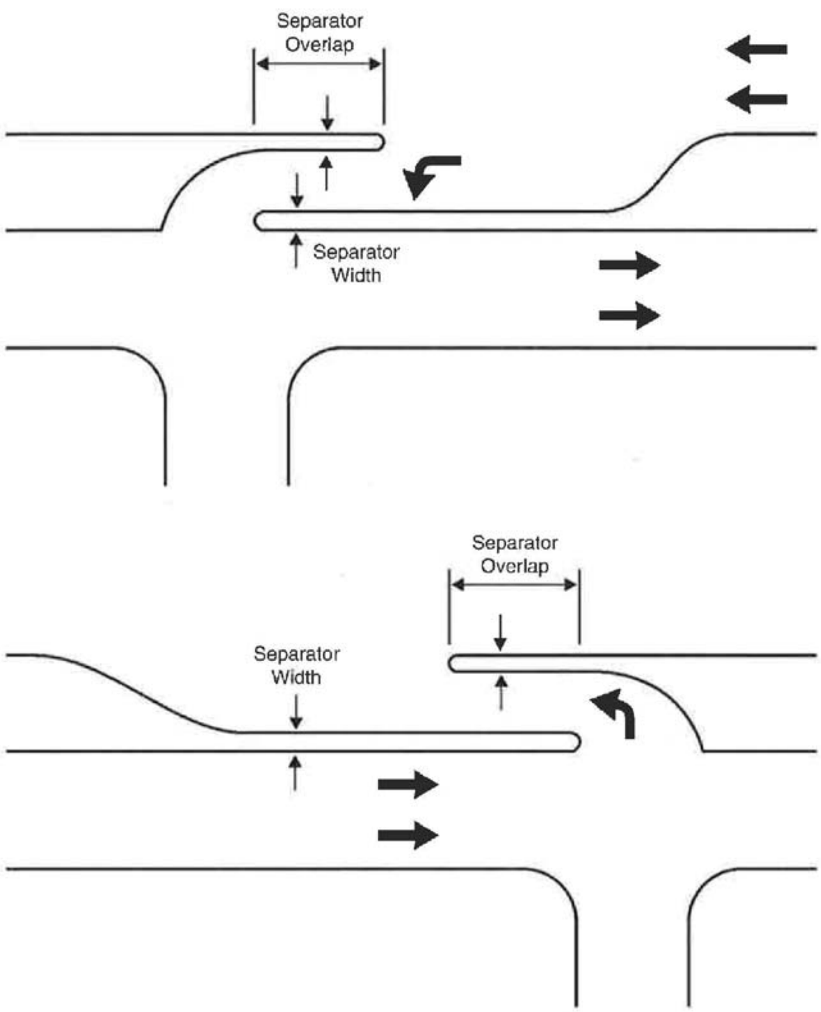
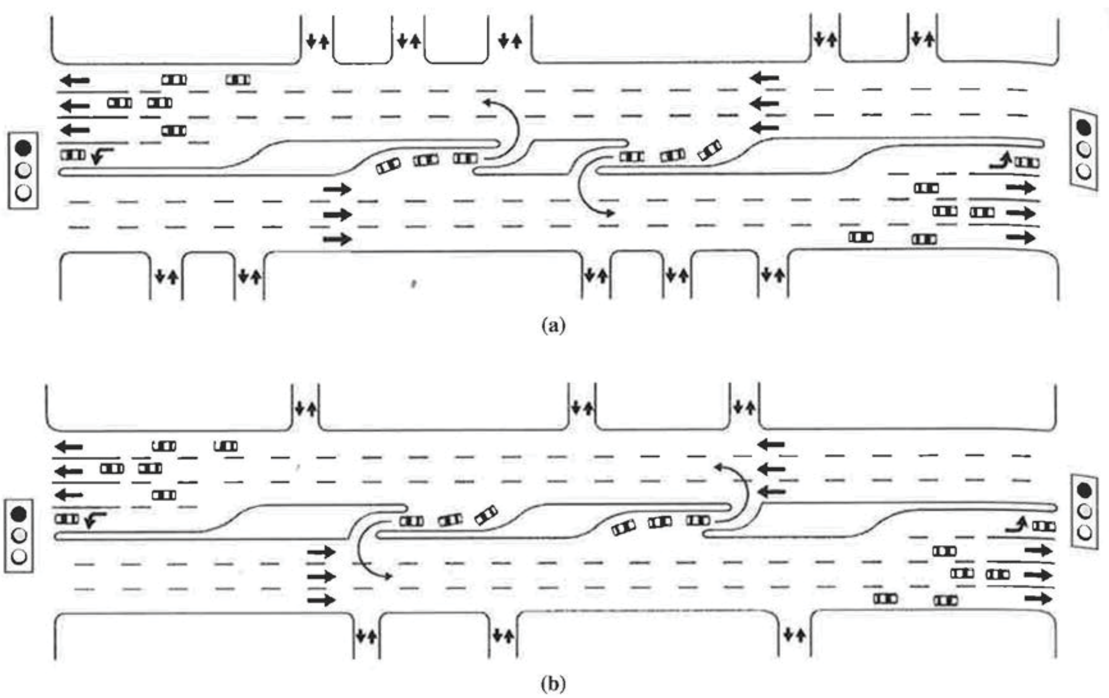


Figure 5.4 – Unsignalized Directional Median Openings



(a) Downstream from the signalized intersections and (b) upstream from the signalized intersections

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Chapter 6
Auxiliary Lanes

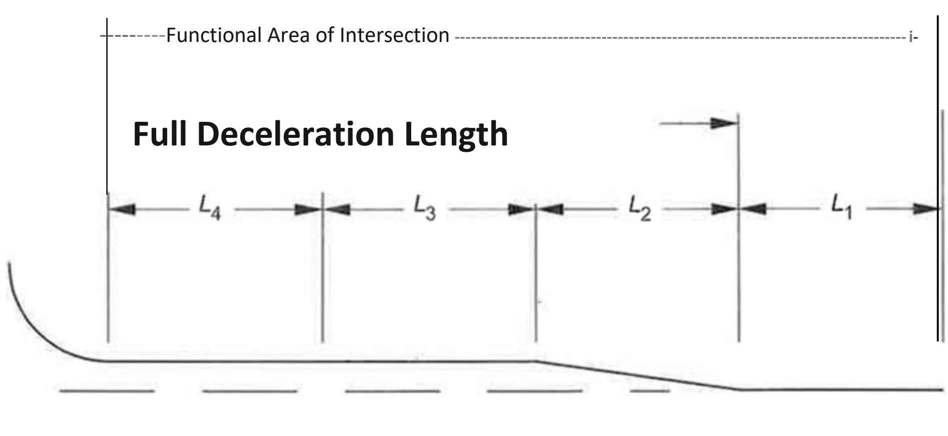
6.1 Auxiliary Lane Guidelines

Auxiliary lanes are any separate lanes used for left and right turning vehicles decelerating or accelerating. Left turn deceleration and storage lanes should be provided at all median openings that allow left and/or u-turns. Right turn deceleration lanes should be included when a right turning vehicle will cause the through traffic to slow or create congestion in the outside lane.

6.2 Auxiliary Lane Storage Length

The minimum physical length of a right-turn or left-turn bay, including the taper, consists of the maneuver distance plus the queue storage. The distance to maneuver laterally and decelerate to a stop is the same for left-turn bay as for right-turn bays, because the initial speed and the speed at which the turning vehicle clears the through-traffic lane are the same. Additional details on the design of left-turn and right-turn bays are provided in Transportation and Land Development, and the AASHTO "Green Book", latest edition. See the figure below.

Figure 6-1 - Functional Area Upstream of an Intersection



Notes: L_1 = Distance traveled during perception-reaction time
L_2= Taper distance to begin deceleration and complete lateral movement
L_3 = Distance traveled to complete deceleration to a stop
L_4= Storage length

6.3 Deceleration Length

Provision for deceleration clear of the through-traffic lanes is a desirable objective on arterial roads and streets and should be incorporated into design, whenever practical. Table 6-1 presents the estimated distances needed by drivers to maneuver from the through lane into a turn bay and brake to a stop.

Table 6.1 - Desirable Maneuver Distances

$L_2 + L_3$ in Figure 6.1

Speed (mph)	Distance (ft)
20	70
30	160
40	275
50	425
60	605

NOTE:

1. Assumes a turning vehicle has “cleared the through lane” when it has moved laterally approximately 9 feet so that a following through vehicle can pass without encroaching upon the adjacent traffic lane.
2. The speed differential between the turning vehicle and following through vehicles is 10 mph when the turning vehicle “clears the through traffic lane.”
3. 5.8 ft/s^2 deceleration while moving from the through lane into the turn lane; 6.5 ft/s^2 average deceleration after completing lateral shift into the turn lane.
4. Rounded to 5 ft.

The turn lane must be of adequate length to store vehicles waiting to complete the turn. The turn bay length at a signalized intersection will be affected by the signal timing, the percentage of large vehicles, and the turn rate for the design hour. The length may also be controlled by either off-peak or peak period conditions, so both must be calculated, with the longer of the two being the more desirable design length.

Dual left-turn lanes may be considered when the turning volume reaches 200 vehicles per hour. The length of a dual turn lane can be estimated by dividing the storage length by 1.8. The value of 1.8 provides some allowance for an unequal distribution of vehicles in the turn lanes.

Chapter 7
Connectivity

7.1 Connectivity

Providing a strong connected network of roads and pedestrian facilities can help distribute traffic, reduce travel distances and times, improve routing for transit and reduce walking distances. Good connectivity also provides better routing opportunities for emergency and delivery (solid waste, recycling, mail) vehicles. All of these effects can play a positive role in reducing congestion on the street network.

Connectivity is achieved by providing connections within individual developments, between developments and by having a well-planned collector road network to compliment the arterial highway network.

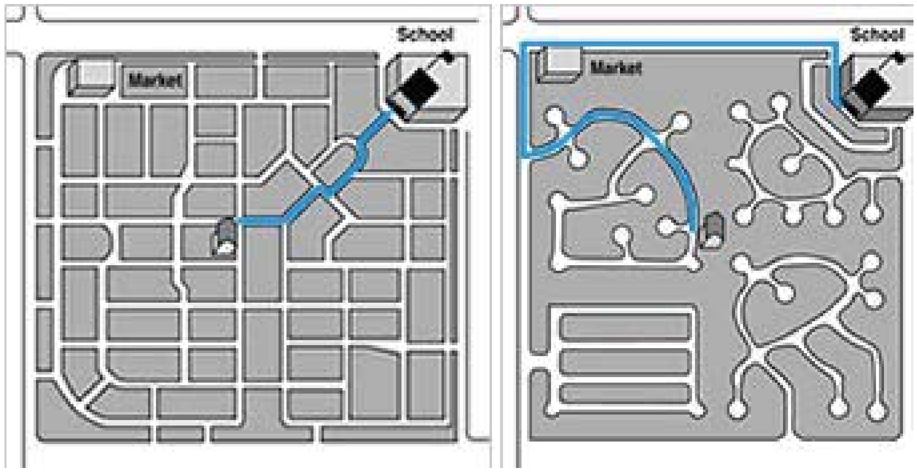
Connectivity is an integral component of access management. All of the previously discussed components of access management, i.e., spacing of access points, medians, auxiliary lanes, etc., can by utilized, but if the roadway system will still be ineffective if it is not cohesive. By following the functional classification of the roadways, a cohesive system of travel throughout the city can be achieved.

Emergency response is enhanced with greater connectivity and will improve citizen safety and peace of mind. If the only access point to a subdivision is blocked due to a traffic accident, or flooded by heavy rains, emergency personnel may be hampered, delayed or cannot reach the emergency in time to prevent a disaster. With more than one alternate way to gain access to a site, subdivision or other facility, the emergency response is enhanced for all who need the service.

An example of neighborhood connectivity is shown in Figure 7.1. Comparison of the two maps shows that the trip from home to school in the “Desirable” figure does not have to use the arterial streets to be completed (keeping the trip local in nature), versus the “Undesirable” figure where all trips to school must use the major arterial street. The trip length in the “Undesirable” figure is five times longer that the trip length in the “Desirable” figure, resulting in increased fuel consumption, additional congestion on the major arterial and additional travel time.

The Transportation Plan presented in this Manual provides uninterrupted collector connectivity to developing neighborhoods, intra-city minor arterial, and inter-city major arterial, travel destinations. Major benefits of connectivity include emergency response and higher roadway efficiencies that improve travel time and reduce congestion and costs to build larger roads.

Figure 7.1 – Roadway Connectivity Example



Desirable Undesirable

7.2 Parcel Level

Connectivity can also be thought of as having more than one access to a side road for a large development, having cross access, i.e., connecting more than one driveway by a frontage road or connecting more than one development to one driveway. Connectivity allows trips to be distributed between the internal systems and the hierarchy of the roadway structure. A variety of street types should be included in development plans to help interconnectivity and reduce unnecessary trips on major roadways. A common access management tool used to promote connectivity within developments is the use of frontage roads. These roads allow the traffic that would normally use the main road to access a business to use an alternate parallel road, the frontage road, to make their turns. Connectivity also allows for pedestrian routes, which encourage walking between destinations, and removes internal trips from the adjacent road network.

The City may require the use of frontage roads to provide access to property adjacent to Arterial roadways or as shown on the Transportation Map. The landowner/developer may be required to construct the frontage road to the side and/or rear property lines or reserve sufficient right of way to allow future construction. As adjacent property develops landowner/developers shall be required to interconnect the individual portions of frontage roads as appropriate. Access to the roadway via an intersecting street or a shared driveway may be required if the use of a frontage road is not feasible.

7.3 Subdivision Level

The ability to travel between subdivisions reduces fuel consumption, reduces exhaust emissions, saves time, improves safety, and reduces vehicle miles traveled. Subdivisions must be designed to move traffic from local streets to collectors that will provide access to higher level roads. Local trips from one subdivision should use collectors to go to the next neighborhood. If traffic is forced to go out of the neighborhood to use an adjacent arterial road to access the next subdivision, the number and length of trips increases on arterials and causes congestion, reducing the effectiveness of the entire transportation system. The arterial roadway must be preserved for moving vehicles and people from one part of the city to another.

The interconnectivity of neighborhoods must be reflected in the original layout of subdivisions through the Planning and Zoning process and the Comprehensive Plan process. Individual properties that come in for rezoning must consider connections to future development on adjacent tracts of property. Collector roads must be constructed at the time of development so that the future development will have adequate access to the higher classification of streets and not force excessive traffic on local streets.

All subdivisions shall extend stub streets to the end of the tract boundary and dedicate public right of way for the future extension of the street into the next tract of land.

7.4 City level

Major and minor arterials must be planned so that through traffic has proper facilities to move from one portion of the city to another while not sending overflow traffic through neighborhoods. Access management must be employed to ensure as much capacity as necessary is available to provide safe and efficient roads for the community.

Connectivity of the arterial system also is beneficial because it gives more alternative routes to bypass portions of the city. If the only minor arterials all went through the center of the city, anyone wanting to travel from the north side to the south side of town, would be forced to go through downtown, causing congestion and gridlock. By providing alternative routes around downtown, traffic in that area of the city would be reduced, balancing traffic flow and improving efficiency.

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Chapter 8
Traffic Signs, Markings, Signalization and Neighborhood Traffic Management

8.1 Introduction

Effective access management for future proposed roadways will provide benefits for not only the new development areas, but also may be effective in controlling traffic issues in existing neighborhoods. The use of traffic signs, markings, signalization and neighborhood traffic management is also an effective way to manage access issues.

The purpose of this chapter is to define standards for traffic control devices based upon the recommendations of The Manual on Uniform Traffic Control Devices (MUTCD), current edition, published by the Federal Highway Administration. This chapter also provides some techniques for traffic calming techniques in existing neighborhoods.

8.2 Traffic Signs, Markings and Signalization Requirements

All development projects undertaken in Richmond shall follow and use the MUTCD standards. All traffic studies shall use the MUTCD for design of traffic signs, markings, and signalization. All plans must be approved through the City of Richmond and/or Kentucky Department of Highways (KDOH) with regards to traffic signage, markings, and signalization.

8.3 Neighborhood Traffic Management (NTM)

- **Goals**

  It is the goal of the City of Richmond to establish procedures and techniques that will promote neighborhood livability by mitigating the negative impacts of automobile traffic on residential neighborhoods.

- **Objectives**

  The objectives for Neighborhood Traffic Management are to promote safe and pleasant conditions for residents, pedestrians, bicyclists, and motorists on local neighborhood streets as follows:

  - To encourage the designed use of the total street system, including the reduction of cut through vehicular traffic on local neighborhood streets.
  - To reduce the speed of traffic on local neighborhood streets.
  - To preserve and enhance pedestrian and bicycle travel within neighborhoods.
  - To encourage citizen involvement in neighborhood traffic management process.
  - To achieve efficient and safe movement of traffic within neighborhoods (including

emergency vehicles) consistent with the intended function of the neighborhood streets.
- To maintain acceptable levels of service on the city's arterials so as to avoid intrusion/diversion onto local neighborhood streets.

- **Techniques**

There are a number of techniques that may be needed to address differing traffic conditions in neighborhoods. Traffic calming techniques generally fall under two categories - physical and psychological. Some traffic calming techniques are designed to physically change the width or surface of the street. Traffic calming may also be achieved by changing the psychological feel of the street. These changes may give motorists cues that they are no longer on a major roadway but are in a different environment that is shared with people.

All traffic calming techniques have a limited range of effectiveness. To achieve traffic calming objectives, some techniques need to be placed every 250 - 400 feet. Some techniques include speed humps, narrowing of pavement, installing landscape areas, corner bump-outs, roundabouts, etc. If traffic calming techniques are used too sparsely, traffic may slow close to the installation, but the overall speed will probably not decrease. One technique may be used multiple times or multiple techniques may be used in conjunction with one another. Most techniques will affect noise, air quality, congestion, fuel consumption, and many other factors. Some can improve these conditions; others may cause these problems to increase.

Emergency vehicle access and response time must be considered when designing and installing traffic calming devices. Emergency vehicles, particularly ambulances, have more difficulty with "vertical" devices such as speed humps than with "horizontal" devices such as neckdowns.

Likewise, bicyclists and pedestrians must be kept in mind when developing a traffic calming strategy, as some devices can obstruct their movements. Many devices can be modified to allow bicyclists and pedestrians to by-pass them. For instance, a diverter can be fitted with a bicycle / pedestrian link to allow for their through movement.

Section B - Roadway Manual

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Chapter 9
Introduction

9.1 Purpose

The proper design and construction of roads and streets is of utmost importance to any community that wants to maintain a structurally sound infrastructure. This infrastructure is used to provide mobility to the public, including businesses, residents, tourists, motorists, bicyclists, pedestrians and any other use of the public right of way. The purpose of this manual is for use in the design and maintenance of roadways in the City of Richmond. This manual draws upon nationally accepted standards for roadway planning and design. The manual is intended for use by:

- The City of Richmond
- Engineers designing local roadways
- Commercial, Industrial and residential developers

9.2 Terms and Definitions

To ensure easier use and interpretation of this manual, certain words, terms, and phrases are interpreted and defined within this section. The terms and definitions used in this manual are drawn from definitions in common use by: the City of Richmond, the Kentucky Transportation Cabinet (KYTC), the American Association of State Highway and Transportation Officials (AASHTO), the Transportation Research Board (TRB), and the Institute of Transportation Engineers (ITE). If a word is not specifically defined within this section, but is used within the context of this manual, it is assumed that the word is defined by its common English definition. When standards referenced within this manual change, the most current standards will apply.

It is further assumed in the context of this manual that words used in the present tense include the future tenses; words in the singular number include the plural; and words in the plural include the singular. The word "person" includes a firm, partnership, or corporation, as well as an individual. The word “street” and the word “road” are used interchangeably within the context of this manual; the word "lot" includes the word "plot" or "parcel"; and the word "building" includes the word "structure.” The terms "shall" and "will" are always mandatory and not directory, and the word "may" is permissive.
Terms and Definitions are located in Appendix A.

9.3 Federal, State, and Local Permits/Laws

This roadway manual is to be used in conjunction with federal, state, and local permit requirements and laws. The manual in no way supersedes federal, state, and local permitting or design requirements dealt with in other laws and ordinances. When referenced standards change, the most up-to-date standards and requirements will apply.

9.4 Standard Drawings and Specifications

References to "standard drawings and specifications" within this manual are in reference to the standardized drawings utilized by the City of Richmond, or those used by the Kentucky Department of Highways.

9.5 Referenced Documents and Manuals

Numerous technical documents were used as references materials in the development of this document. These documents are included in Appendix B, Reference Documents.

9.6 Submission Requirements for Roadway Construction

All projects presented for development plan approval shall submit all documents, soils or geotechnical testing, any other tests required, all required approved permits from state, federal, local, or other jurisdictions, and all other documentation required in this manual before final plan approval is issued to begin construction.

9.7 Design and Construction Activities

Design requirements shall be based on the specifications in this manual. Construction activities shall be based on KYTC Standard Specifications for Road and Bridge Construction. Items not covered by the KYTC specifications shall require a special design by the Engineer and shall be approved by the City of Richmond.

9.8 Street Names

Street names shall be selected which will not duplicate, nor be confused with, names of other existing streets in Madison County. Proposed streets which are clearly in alignment with existing streets shall bear the name of that street. Generally, no street should change direction by ninety (90) degrees without a name change.

9.9 Street Signs

The developer shall be responsible to purchase, provide and install all temporary and permanent street signs for any subdivision or street construction activity related to the development, according to city standards.

9.10 Street Lights

The developer will provide for the installation of street lighting systems within the city limits. Street lights shall be placed on standard fixtures installed by the appropriate utility agency. Ornamental/decorative lighting is permitted as an alternative to the standard fixture. All property owners on the street where ornamental/decorative lighting is installed shall be assessed on an annual basis (Ord. 92-44). If applicable the alternative street assessment shall be noted on the final plat.

9.11 Right of Way Dedication

For any development fronting on an existing street or roadway, being constructed on lots that have not been platted (i.e. metes and bounds deed descriptions that extend to the centerline of the roadway), the developer shall be required to dedicate all required right of way to the City of Richmond, commensurate with the type of street being constructed. As an example, a local street shall require a dedication of 25 feet from the centerline; a collector shall require a dedication of 30 feet from the centerline.

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Chapter 10
Roadway Specifications and Typical Sections

10.1 Introduction

Roadways constructed for the City of Richmond will serve a variety of transportation needs. Each one of these types of roads will require a different pavement design and typical section. Arterial roadways will typically be constructed for the purpose of moving traffic from one side of town to the other and will probably be designed by the city or the KYTC. Higher state and national guidelines will be used to design these higher classes of roads than that shown in this manual.

10.2 Street Standards

Collector and local streets will be designed and constructed according to the guidelines in this manual. The following table is a compilation of design parameters that are to be used in the design of these roadways.

Table 10.1 - Required Roadway Dimensions and Characteristics

	COLLECTOR STREETS		LOCAL STREETS			
	RESIDENTIAL	NON-RESIDENTIAL	CONTINUING	LOOP/ CUL-DE-SAC	SERVICE ROAD	NON-RESIDENTIAL
STREET DIMENSIONS						
Right-of–Way Width	60’	70’	50’	50’	40’ – 50’	60’
Roadway Width (face to face)	40’	40’	30’	30’ (*3)	30’	40’
Curbs and Gutters	Yes	Yes	Yes	Yes	Yes	Yes
Sidewalk (width and sides)(*5)	4’ (both)	4’ (both)	4’ (both)	4’ (both)	4’ (*1)	4’ (both)
Driveway Access	(*1) Yes	(*1) Yes	Yes	Yes	Yes	Yes
Double-Frontage Lots	(*1) No	(*1) No	No	No	No	No
Street Grade (Maximum)	8%	8%	10%	10%	10%	6%
Street Grade (Minimum)	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
Pavement Cross Slope	¼” / ft.	¼” / ft.	¼” / ft.	¼” / ft.	¼” / ft.	¼” / ft.
Cut Slopes (Minimum)	2:1	2:1	2:1	2:1	2:1	2:1
Fill Slopes (Minimum)	2:1	2:1	2:1	2:1	2:1	2:1
STREET ALIGNMENT						
Horizontal Curve Radius	500’	500’	250’	100’	150’	300’
Stopping Sight Distance	250’	250’	200’	200’	200’	200’
Crest Vertical Curve Formula	(*4)	(*4)	(*4)	(*4)	(*4)	(*4)
Crest Vertical Curve (Minimum)	100’	100’	100’	100’	100’	100’
Sag Vertical Curve Formula	(*4)	(*4)	(*4)	(*4)	(*4)	(*4)
Sag Vertical Curve (Min)	100’	100’	100’	100’	100’	100’
STREET INTERSECTION						
Maximum Street Legs	4	4	4	4	4	4
Intersection Angle (Preferred and Minimum)	90° - 80°	90° - 80°	90° - 80°	90° - 80°	90° - 80°	90° - 80°
Intersection Spacing	(*2)	(*2)	(*2)	(*2)	(*2)	(*2)
Curb Radius Along Street	(*1)	(*1)	20’	20’	20’	20’ – 40’
Max. Grade within 50’ of Intersecting Gutter	3%	3%	3%	3%	3%	3%
Max. Tangent Offset within 100’ of Intersecting Gutter	8.3’	8.3’	11.3’	11.3	11.3’	11.3’

(*1) As approved by the Planning Commission

(*2) Intersection spacing shall apply as described this manual

(*3) Alternate dimensions of 23’ or 27’ (face-to-face roadway width may be utilized as described in Typical Sections for local streets).

(*4) Refer to AASHTO’s “A Policy on Geometric Design of Highways and Streets.”

(*5) Installation of all sidewalk and ramps shall be compliant with current ADA guidelines.

NOTE: See Section **10.6, Approved Streets**, for private street regulations.

10.3 Typical Sections

The following cross-sections shall be considered typical for the situations listed. Other cross-sections may be required by the Planning Commission upon advice from the Planning and Zoning staff, based upon the design of the actual situation encountered. Some existing stub streets were constructed using cross- sections that are now obsolete. These streets should be completed using the obsolete cross-section to an appropriate stopping point, which is customarily the next street intersection. Cross-sections for arterial streets or other roadways, larger than those shown in this exhibit, shall be designed by the City of Richmond and/or the Kentucky Department of Transportation, as appropriate. Figures 10.1 through 10.5 depict typical sections for representative roadway types.

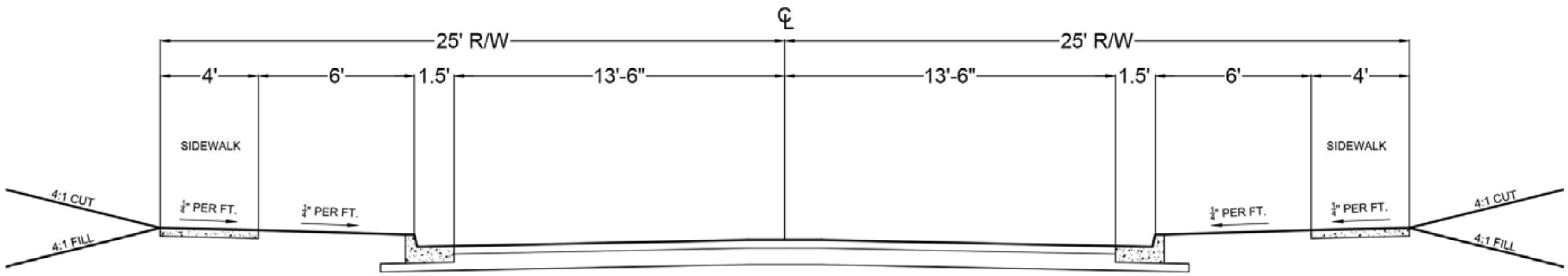
10.4 Complete Streets

The concept of complete streets has changed the perception of what a transportation project should be to improve community mobility. Instead of focusing on the movement of motorized vehicular traffic, which sometimes create barriers to community interaction, complete street design focuses on retaining community character and sense of place while improving public safety for all forms of transportation including: pedestrian, non-motorized, mass transit and motorized vehicular traffic. Communities that embrace the complete streets concept find numerous physical and social benefits for their community.

Complete streets function for all users regardless of age or ability in a safe and efficient environment including pedestrians, bicyclists, motorists and transit riders. Incorporating complete streets into the community means a fundamental shift in transportation planning and design. This shift yields a safer and more connected transportation network for all users ultimately creating a better place to live.

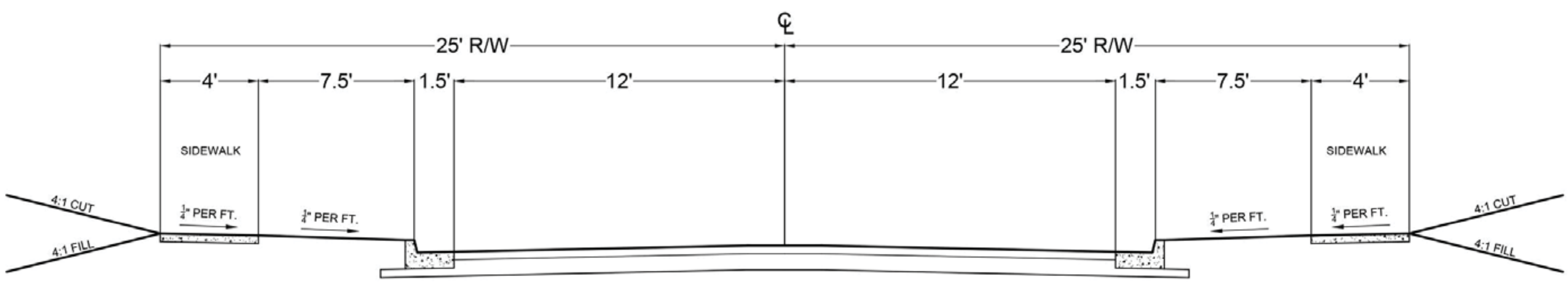
There is no singular design prescription for Complete Streets; each one is unique & responds to its community contextual setting. A complete street may include some if not all of the following: sidewalks, bike lanes (or wide paved shoulders), special bus lanes, comfortable & accessible public transportation stops, frequent & safe crossing opportunities, median islands, accessible pedestrian signals, curb extensions (bump-outs), narrower travel lanes, roundabouts, & more elements. Whenever a new street is constructed, whether by a developer or the city, all aspects of a complete street design should be considered.

Figure 10.1 – Typical Section for Residential Local, Cul de Sac over 500 Feet Long, Commercial Service Road; Residential Cul de Sac Under 500 Feet Long



RESIDENTIAL LOCAL, CUL-DE-SAC OVER 500' LONG, COMMERCIAL SERVICE ROAD TYPICAL SECTION

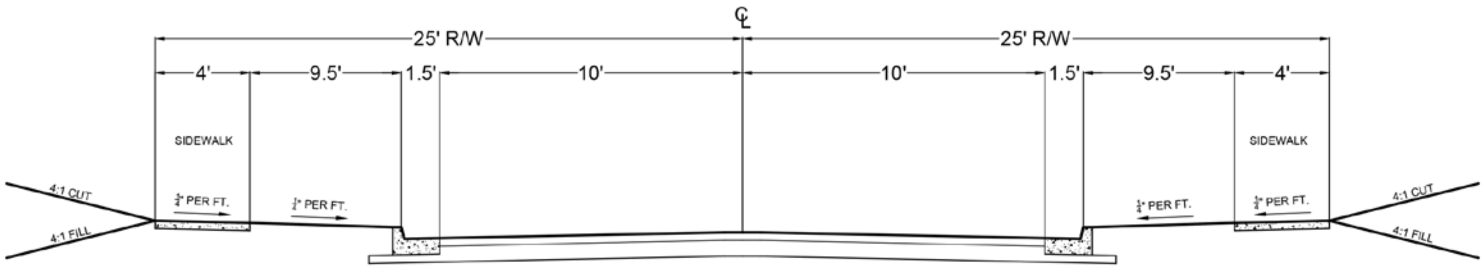
NTS



RESIDENTIAL CUL-DE-SAC UNDER 500' LONG, TYPICAL SECTION

NTS

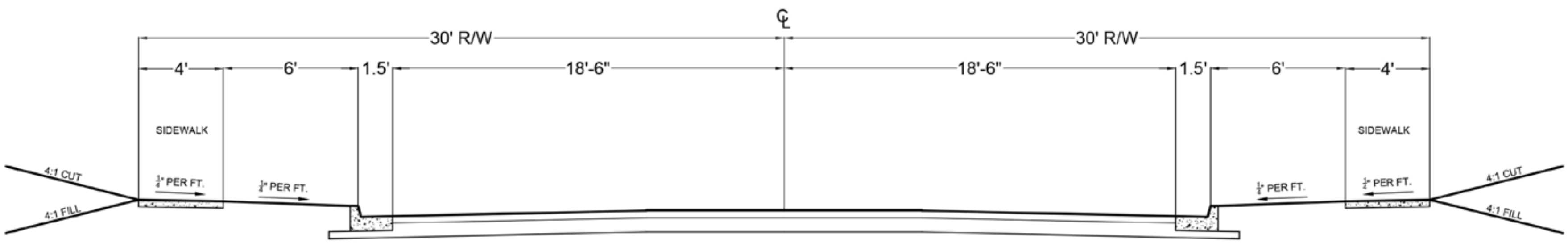
Figure 10.2 – Typical Section for Residential Special; Residential Collector, Non-residential Local



RESIDENTIAL, TYPICAL SECTION, SEE NOTE BELOW

NOTE: RESIDENTIAL LOCAL WHERE 15 UNITS OR LESS HAVE ACCESS, OR THE AVERAGE LOT WIDTH IS GREATER THAN 100' (SINGLE FAMILY HOMES ONLY); AND WHERE TWO PARKING SPACES PER BEDROOM ARE PROVIDED BEHIND THE BUILDING LINE, EACH HAVING INDEPENDENT ACCESS TO THE STREET.

NTS

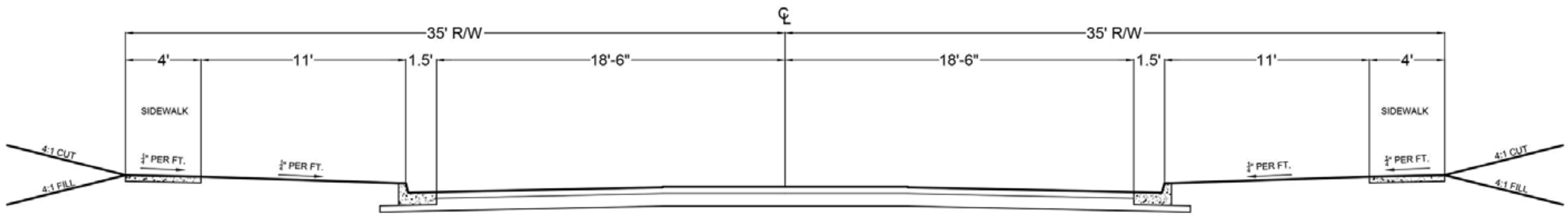


RESIDENTIAL COLLECTOR, NON-RESIDENTIAL LOCAL STREET TYPICAL SECTION

NOTE: SIDEWALK MAY BE ELIMINATED ON ONE SIDE WHEN STREET IS COMPLETELY CONTAINED WITHIN AN INDUSTRIAL AREA.

NTS

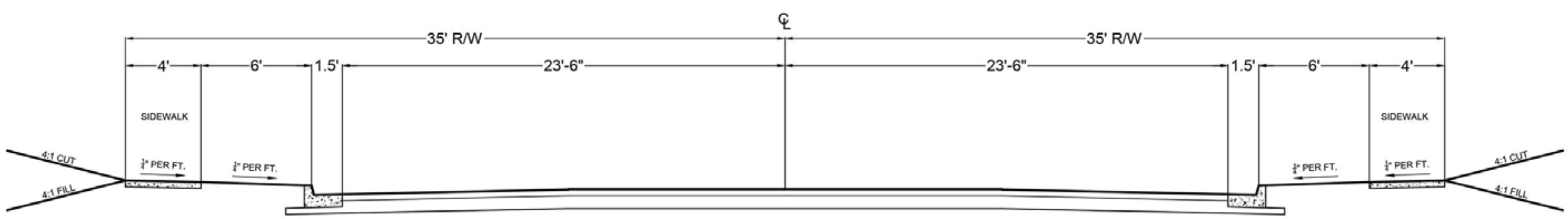
Figure 10.3 – Typical Section for Non-Residential Collector, Industrial Area; Non-residential Collector, Intersection with Arterial Street for at least 250 Feet



NON-RESIDENTIAL COLLECTOR, INDUSTRIAL AREA TYPICAL SECTION

NOTE: SIDEWALK MAY BE ELIMINATED ON ONE SIDE WHEN STREET IS COMPLETELY CONTAINED WITHIN AN INDUSTRIAL AREA.

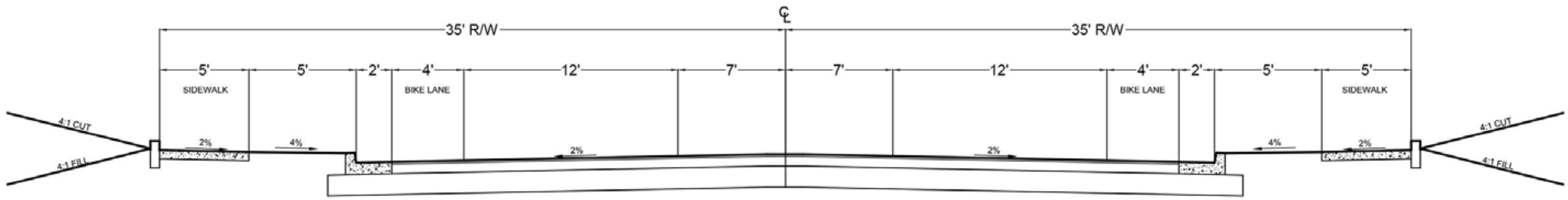
NTS



NON-RESIDENTIAL COLLECTOR, INTERSECTION WITH ARTERIAL STREET FOR AT LEAST 250'

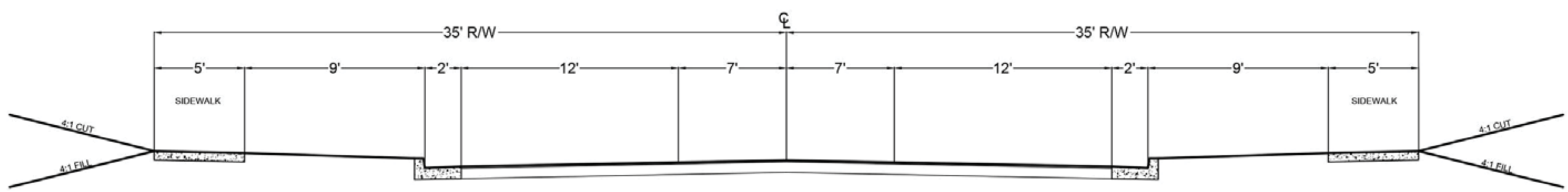
NTS

Figure 10.4 – Typical Section for Minor Arterial, Two-Way-Left-Turn Lane with Bike Lanes; Minor Arterial, Two-Way-Left-Turn Lane



MINOR ARTERIAL, TWO-WAY-LEFT-TURN-LANE WITH BIKE LANES

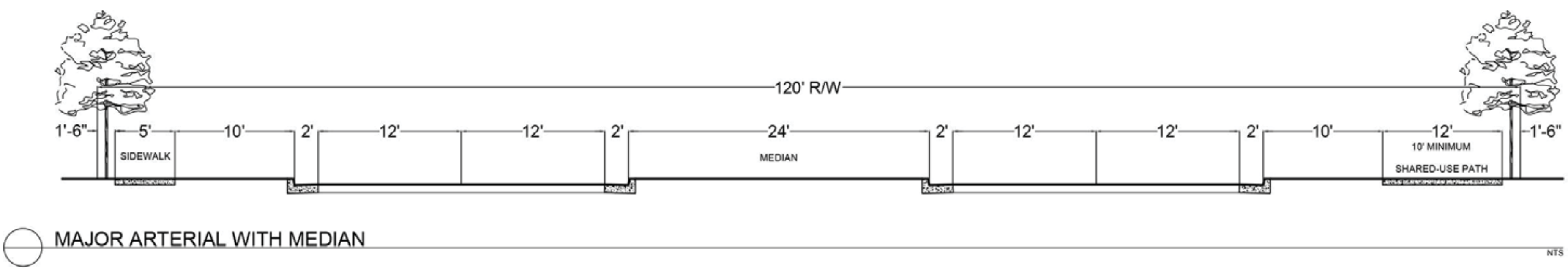
NTS

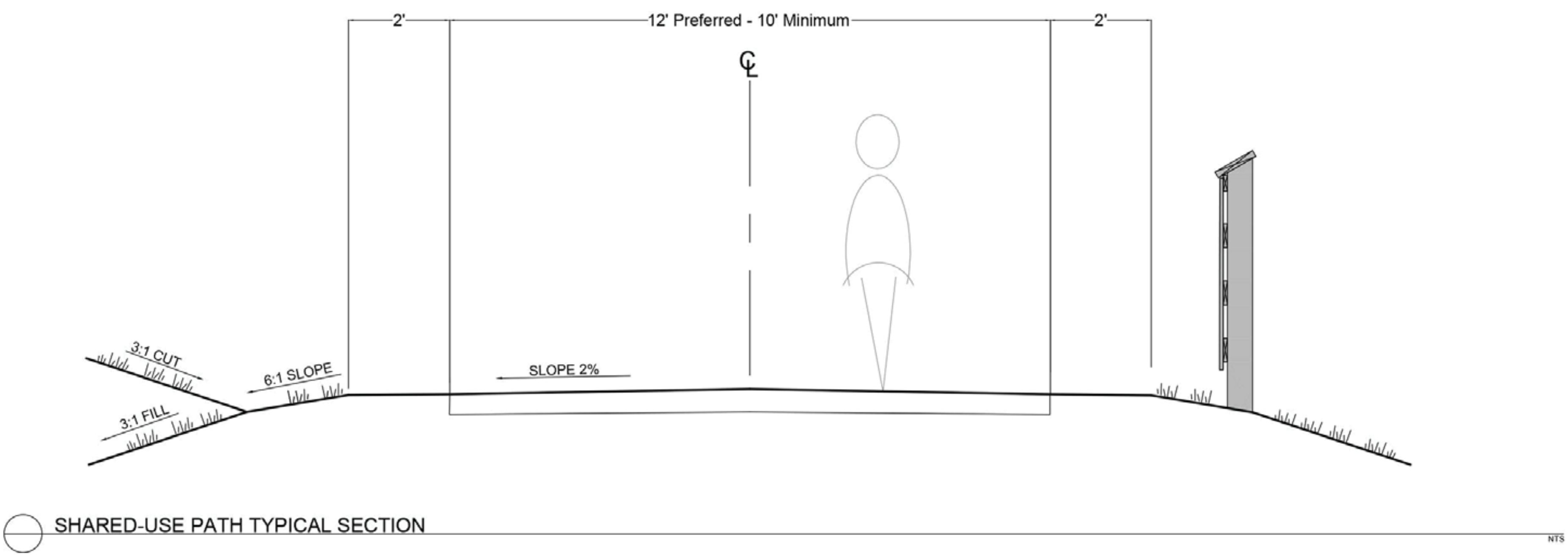


MINOR ARTERIAL, TWO-WAY-LEFT-TURN-LANE

NTS

Figure 10.5 – Typical Section for Major Arterial with Median; Shared-Use Path





10.5 Green Streets

The concept of a green street provides a balanced approach to meet the transportation needs of pedestrians, bicyclists and motorists while incorporating stormwater quality and quantity best management practices. As a permitted community under Kentucky Pollutant Discharge Elimination System (KPDES), the City of Richmond is required to meet certain water quality provisions of the EPA's Clean Water Quality Act of 1987. Thus, the green street model provides a practical and cost-effective option to address Richmond's permitting obligation. Green Streets provides reduction of stormwater runoff by diverting rainwater from other infrastructure networks including: sanitary sewer systems, basement foundation drainage, and combined sewer overflows (CSOs) thus improving overall water quality. The green street improvements are completed within the street right-of-way similar to the Complete Street model.

A Green Street addresses stormwater on-site through use of vegetated areas; provides water quality benefits and replenishes groundwater (if an infiltration BMP is installed); meets broader community goals by providing improved pedestrian and, bicycle facilities; and serves as an urban greenway segment that connects neighborhoods, parks, recreation facilities and schools. The installation of a green street creates attractive and safer streetscapes that enhance a community's livability for all users of the public right-of-way. The goal of a green street should be to create synergy within Richmond's infrastructure by enhancing and expanding the public open space, preserving or improving the character of the surrounding land use while providing water quality and quantity benefits for the community.

The design and function of green streets should vary with the surrounding land use and community activities. Urban, campus, and suburban streets should each respond to their environment and develop unique and distinctive characteristics. A green street integrates a number of treatments that may include accessible sidewalks, traffic calming, road diet, rain gardens, vegetative swales, planter boxes, street trees within stormwater filter units and other pedestrian-scaled features. The implementation of the green streets program should be a part of an overall Stormwater Low Impact Development (LID), Green Infrastructure, Smart Growth policy that offers mixed-use development options with multi-functional infrastructure which would reduce the demand for increased infrastructure capacity, while meeting general water quality requirements.

10.6 Approved Streets

Any vehicular way approved by the City of Richmond as providing access to a property either being a public or private street as follows:

- **Public Streets**

  Public streets are streets dedicated to the public use and which are maintained by the City of Richmond.

- **Private Streets**

  Private streets are streets owned by and dedicated to use by a specific subdivision or homeowners' association. Private streets may be permitted by the City of Richmond. Subdivision plans containing private streets shall conform to all other subdivision regulations. Private streets are streets constructed, used, and maintained under the provisions of the Subdivision Regulations and have identical design standards as Public Streets. Construction guarantees shall also be the same as for public streets, as outlined in Section 516 of the Development Ordinance. The Section below outlines the special requirements for private streets.

  - **Special Requirements for Private Streets**

    - No Disruption to Through Movement: Private streets may be permitted only if they meet the definition of local streets; if they provide absolutely no present or future impediment to necessary through traffic movement in the general area; and, if adjoining properties and the general area already have, or are capable of providing a proper, efficient and safe street system that will in no way depend upon the private streets.

    - Right-of-Way Setback: Private street right-of-way and building setback lines shall be shown on the plat and shall at least meet minimum requirements of the Development Ordinance required for public streets to assure conformance if such streets are ever accepted for public dedication at a later date.

    - Street Improvement Standards: Private streets shall conform to the design standards set for public streets.

- Future Acceptance by Government: Any plan containing permitted private streets shall have such streets so labeled and shall contain the following signed certification by the owner: "*Private Street Responsibilities of the Owners - The owners of this property and any successors in title hereby agree to assume full liability and responsibility for any construction, maintenance, reconstruction, snow removal cleaning or other needs related to the private streets so designated on this plan, and do hereby fully relieve the City of Richmond from any such responsibility. The owners understand that the private streets will not result in any reduction in taxes required by and payable to the city of Richmond. Furthermore, if the owners in the future should request that the private streets be changed to public streets, the owners do fully agree that before acceptance of such streets by the City of Richmond, the owners will bear full expense of reconstruction or any other action necessary to make the streets fully conform to the requirements applicable at that time for public streets prior to dedication and acceptance. Finally, the owners also agree that these streets shall be dedicated to public use without compensation to the owners and without the owners expense in making such streets conform to the requirements applicable at that time for public streets, if at some future date, the City of Richmond so requests.*" (Signed and Dated by Owners.)

- Government and Utility Access: Any plan containing permitted private streets shall show and label all other easements normally required; shall conform to all other applicable sections of the Subdivision Regulations and other local ordinances; and shall contain the owners signed certification: "Government and Utility Access - *The owners of this property hereby agree to grant full rights of access to this property over the designated street, utility, and other easements for governmental and utility agencies to perform their normal responsibilities*." (Signed and Dated by Owners)

- Street Signs: The developer shall provide and install any and all street signs necessary for private street intersections. The owners of the private streets shall also maintain the street signs at their expense. The signs shall be consistent in size and appearance with the City of Richmond standard street sign, but will also identify the street as a private street, with the letters "pvt" at the end of the street name.

- Maintenance Responsibility: Homeowners' association or other mechanism that provides for equitable common responsibility for private street maintenance and repair shall be required to be established by the development's contractor. The contractor's responsibility to create such a mechanism shall be noted on the final plat of the subdivision. A requirement that each property owner be individually responsible for maintenance and repair of the portion of the street abutting the lot shall not be considered as acceptable for fulfilling the requirements of this section.

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Chapter 11
Geometric Design Standards

11.1 General

There are three primary elements that determine the geometric characteristics of a roadway. These are:

- Typical cross section
- Horizontal alignment
- Vertical alignment

Although the three primary design elements essentially establish the geometric characteristics of a roadway, there are numerous secondary design elements that must be considered in the total geometric design. Many of these secondary design elements are discussed here.

For any roadway project, the minimum values used for these primary elements are established based on the design controls and design criteria for the particular roadway. Design controls and design criteria normally considered in the design of a roadway are:

- Functional classification
- Area (urban or rural)
- Volume of traffic (DHV and ADT)
- Percentage of trucks
- Design speed
- Topography (flat or rolling terrain)
- Level of service (*Highway Capacity Manual* for detail)
- Special considerations such as the length of project, the condition of roads in the vicinity of the project, and the likelihood of adjoining segments being improved in the foreseeable future.

In the early stages of a project, geometric design criteria shall be coordinated with the City of Richmond. In a few cases, the typical cross-section design may depend also on whether or not the project is to be financed with state or federal-aid funds.

The Geometric Design Criteria for each classification of roadway are used to determine the values for each of the components that make up the typical cross-section (i.e., pavement width and slope, shoulder width and slope, ditch width and slope, and typical earth slopes in cuts and fills for typical street sections.) Also, refer to the City of Richmond's "*Standard Drawings*."

11.2 City of Richmond Standard Drawings

The city of Richmond's "*Standard Drawings*," current edition shall be used in conjunction with this manual. The engineer is referred to these standard drawings for additional information and background material concerning the design criteria presented in this manual.

11.3 Kentucky Transportation Cabinet (KYTC)

The Kentucky Transportation Cabinet's "*Standard Drawings*" and "*Standard Specification for Road and Bridge Construction*," current edition has also been approved for use in conjunction with this manual. The engineer is referred to this manual for additional information and background material concerning the design criteria presented in this manual.

11.4 AASHTO Guidelines

The American Association of State Highway and Transportation Officials (AASHTO) is an organization that investigates and comments on the design policies of all states. The latest edition of AASHTO's "*A Policy on Geometric Design of Highways and Streets*" has been approved for use in conjunction with this manual. The engineer is referred to the AASHTO manual for additional information and background material concerning the design criteria presented in this manual.

11.5 Manual on Uniform Traffic Control Devices

The U.S. Department of Transportation Federal Highway Administration's "*Manual on Uniform Traffic Control Devices (MUTCD)*" current edition has been approved for use in conjunction with this manual. The engineer is referred to this manual for additional information and background material concerning the design criteria presented in the manual.

11.6 Highway Capacity Manual

The Transportation Research Board National Research Council's *Highway Capacity Manual Special Report 209* has been approved for use in conjunction with this manual. The engineer is referred to this manual for additional information and background material concerning the design criteria presented in this manual.

11.7 Typical Cross Section

There are four basic design controls that are used to determine the typical cross-section for a given roadway:

- Functional Classification
- Area (Rural or Urban)
- Volume of traffic
- Design speed

11.8 Horizontal Alignment

There are several components that comprise the total horizontal alignment design of a roadway. These components and their relationships are discussed below:

11.9 Circular Horizontal Curves

The minimum radius of a curve that can be used for a given design speed is shown in table 10.1. This minimum has been established based on the laws of mechanics. Even though this minimum is allowable, the engineer should always strive to keep horizontal curves as flat as possible.

If compound curves are used, the radius of the flatter curve shall not be more than 50 percent greater than the radius of the adjacent sharper curve.

An alignment where horizontal curves, either in the same direction or opposite direction, are separated by only a short length of tangent roadway should be avoided. This situation creates an alignment that is not pleasing in appearance and also creates problems in superelevation transition. It is preferable to use flatter curves connected by smooth spiral transition curves.

11.10 Spiral Transition Curves

When going from a tangent section into a horizontal curve, or vice versa, a motor vehicle does not follow a path that is parallel to the centerline of the road. The minimum length of spiral curves for given conditions is also shown on these tables. These minimum lengths should be rounded up to even lengths that permit simple calculations. The accepted reference for calculating spiral curves is *Transition Curves for Highways* by Joseph Barnett and AASHTO's "*A Policy on Geometric Design of Highways and Streets.*"

11.11 Superelevation

When a motor vehicle traverses a horizontal curve, centrifugal force tends to move the vehicle radially outward. To help offset this force, the roadway is superelevated on horizontal curves.

Superelevation tables indicate the amount of superelevation to use for a given design speed and radius of curve. In general, a maximum rate of 4.0 percent should be used in urban areas. Refer to AASHTO tables for all other applications. In urban and suburban areas where frequent interruptions in traffic flow are anticipated, and the elevation of existing streets and development must be considered, a lesser rate of maximum superelevation may be used. Local and collector/connector roadways will generally not be subject to superelevation treatment.

The superelevation runoff distance (L) should be the length of spiral, if spirals are used.

The tangent runout, the transition distance from a normal crown section to a flat section, shall be calculated by the formula:

$$R = L * c\ e$$

Where:

L = Length of spiral or length of runoff
c = Normal rate of pavement crown (1/4 “per foot) e = Superelevation rate

11.12 Superelevation at Intersections

The superelevation rates for the through road at an intersection should comply with the appropriate values. At signalized intersections in urban areas, the Engineer may elect to use either reverse crown superelevation or no superelevation, after consideration of (a) vehicle's ability to stop and accelerate during periods of ice and snow, (b) right-of-way damages, (c) grade on existing street approaches and entrances, and (d) drainage.

When introducing or removing superelevation rates, the maximum gradients between pavement edge and centerline profiles from the following table should be used:

<u>Table 11.1 – Design Rate of Cross Slope Change for Curves at Intersections</u>

Design Speed (MPH)	15 & 20	25	30	35 or more
Change in Superelevation Rate (Ft. per Ft.) per 100’	0.075	0.071	0.067	0.065

Reference: Adapted from AASHTO “Green book.”

Superelevated areas adjacent to a through lane having a normal crown, or a different superelevation, result in a "cross-over line" which can cause a hazardous pitch or sway in a vehicle. The maximum difference in superelevation for a road turning away from a through lane is as shown in the following table:

<u>Table 11.2 – Maximum Algebraic Difference in Pavement Cross Slope at Turning Roadway Terminals</u>

Design Speed of Exit or Entrance Curve (MPH)	**Maximum Algebraic Difference in Cross Slope at Cross Over Crown Line (foot per foot)**
15 and 20	0.05 - 0.08
25 and 30	0.05 - 0.06
35 and over	0.04 - 0.05

Reference: Adapted from AASHTO “Green book.”

11.13 Pavement Widening on Curves

When traversing a horizontal curve, the rear wheels of a motor vehicle track inside the front wheels. In addition, it is difficult for a driver to hold the vehicle in the center of the lane when rounding a curve. These problems become more pronounced when lane widths are narrow and curves are sharp.

To partially offset these conditions, pavements shall be widened on horizontal curves when the degree of curve is 5 degrees or greater and the normal lane width is less than 12 feet.

Reference should be made to AASHTO'S "*A Policy on Geometric Design of Highways and Streets*," to determine the amount of widening to be used for a particular radius of a curve. When spiral transition curves are used, the widening should be equally divided between the inside and outside edges of pavement. The widening should transition from zero at the tangent to spiral (T.S.) to full widening at the spiral to curve (S.C.).

When spiral transition curves are not used, all the widening should be done on the inside edge of pavement. The widening should transition from zero at the beginning of the tangent runoff (L) to full widening at the point of full superelevation.

11.14 Lane Width

The width of the traffic lanes on intersecting roads is controlled by the geometrics approved by the City of Richmond. For channelized turning movements, the following lane widths shall be used for the turning road:

Table 11.3 – Curvature and Lane Width (Channelization Only)

Speed (MPH)	15	20	25	30	35	40	45
Radius (Ft.)	50	90	150	230	310	430	550
Lane Width (Ft.)	18	17	16	16	15	15	15
(Widen lanes one foot for each barrier curb used)							

Reference: Adapted from AASHTO "Green book."

11.15 Deceleration Lane Tapers

Tapers or deceleration lanes for vehicles turning from the major road into the minor road are highly desirable for both safety and added capacity. A long radius with no taper is preferable to a short radius and an inadequate taper. On high-speed facilities, taper rates should conform to AASHTO's *A Policy on Geometric Design of Highways and Streets*. However, on most urban intersections, much shorter tapers are satisfactory. Minimum taper rates of 8:1 for speeds up to 30 mph and 15:1 for operating speeds up to 50 mph may be used. (Check the green book for the higher speed ratio)

11.16 Horizontal Sight Distance

Sight distance is the length of roadway that is visible ahead to the driver as he traverses the roadway. In some cases, the sight distance across the inside of horizontal curves is obstructed by objects such as cut slopes, vegetation, buildings, etc. When designing the horizontal alignment, the engineer should check to determine that adequate sight distance is obtained on horizontal curves. In some instances, additional right-of-way may be required. The most recent edition of AASHTO's "*A Policy on Geometric Design of Highways and Streets*" will aid in that determination.

Both stopping sight distance and passing sight distance must be considered. Horizontal sight distance shall be coordinated with the vertical sight distance discussed in the following section of this manual.

Intersection sight distance is an additional subject that is to be considered in roadway design for roads with at-grade intersections. Refer to the ASSHTO "Green Book" and the TRB Access Management Manual for additional information.

11.17 Vertical Alignment

Vertical Alignment - As with horizontal alignment, there are several components that comprise the total vertical alignment design of a roadway. These components and their relationships are discussed below:

- **Grades**

  The grade line is a series of straight lines connected by parabolic vertical curves to which the straight lines are tangent. Under all conditions, these lines should be smooth flowing. Short, choppy grades are unsightly and disrupt roadway and vehicle operating conditions.

  Maximum Grade: The maximum allowable gradient for all roadway classes is based on the design speed and type of terrain. The maximum grades for roads are shown in Table 10.1.

  Minimum Grade: It is necessary to maintain a minimum grade in order to provide adequate drainage; a minimum longitudinal grade of at least 0.80% should be maintained at all times.

11.18 Driveway Grades

Driveways shall be designed with a gradient that will provide for a flat landing area (+ - 3%) adjacent to the edge of right of way. Refer to the Access Management Manual for additional detail for driveway grades.

11.19 Vertical Curves

The transition from one rate of grade to another is effected by the introduction of vertical curves. The curve that is used for this purpose is a simple parabola. All standard route surveying textbooks cover the method of calculating vertical curves and that subject is not covered in this manual.

In addition to sight distance, the engineer should consider riding comfort and appearance when selecting a length of vertical curve. Long curves give a more pleasing appearance and provide a smoother ride than short vertical curves. The most recent edition of AASHTO’s “A Policy on Geometric Design of Highways and Streets” will aid in that determination.

11.20 Sight Distance

Sight distance is the length of roadway visible ahead to the driver. In roadway design, consideration must be given to stopping sight distance and passing sight distance.

11.21 Stopping Sight Distance

Stopping sight distance is that distance that is required for a driver to bring their vehicle to a safe stop after the object becomes visible when traveling at the designated design speed.

11.22 Passing Sight Distance

Passing sight distance is the minimum sight distance required for the driver of one vehicle to pass another vehicle safely and comfortably. Passing must be accomplished without reducing the speed of an oncoming vehicle traveling at the design sped should it come into view after the overtaking maneuver is started.

11.23 Cul-de-Sacs

Cul-de-sacs shall not be longer than one thousand (1000) feet, including the turnaround which shall be provided at the closed end with a right-of-way radius of fifty (50) feet, curb radius of forty (40) feet, and a transition curve radius of seventy-five (75) feet. Longer cul-de-sacs may be permitted because of unusual topographic or other conditions and, in such cases the Planning Commission may require additional paving width if necessary to prevent overloading of street capacity. Temporary turnarounds may be required at the end of stub streets as long as it is retained within the street right-of-way.

Figure 11.1 - Cul-De-Sac with Median

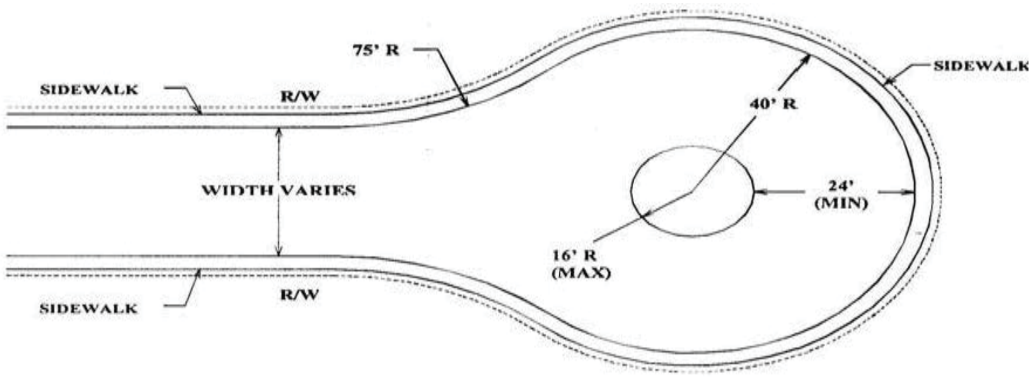
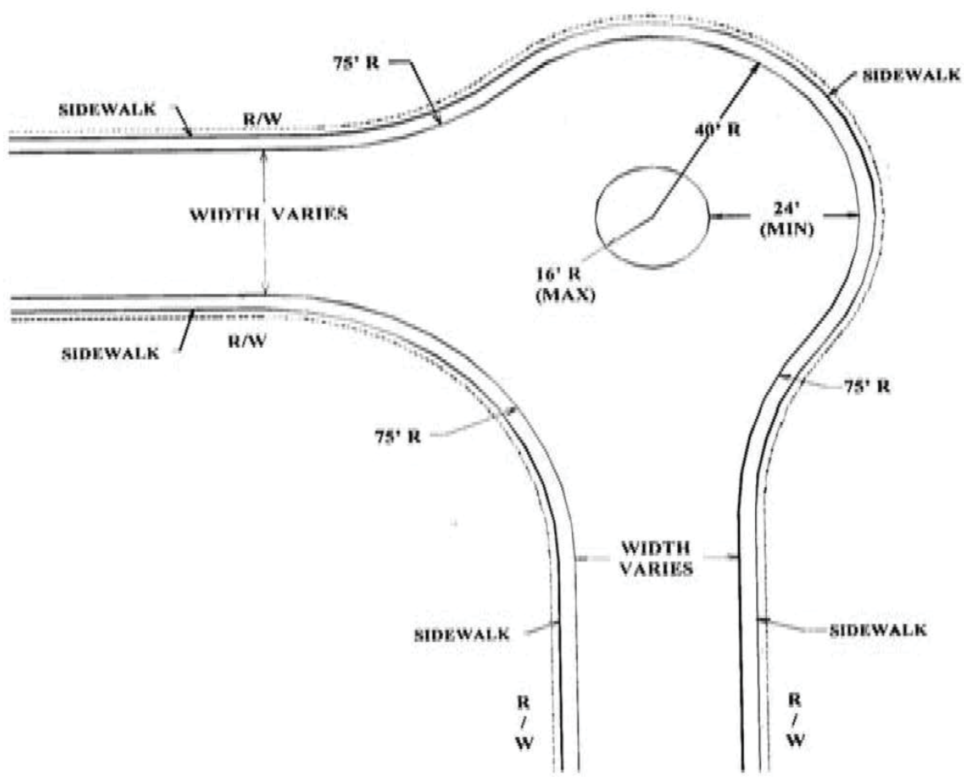


Figure 11.2 - 90° Corner with Added Cul-de-Sac



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Chapter 12
Intersection Design Requirements

12.1 Intersections

An intersection is defined as the general area where two or more roads meet or cross, including the road and roadside facilities for traffic movement within it. An intersection is an important part of a road because the efficiency, safety, speed, cost of operation and capacity depends on its design.

There are three general types of intersections:

- Intersections at-grade
- Grade separations without ramps
- Interchanges

At-grade intersections will be discussed in this chapter. For information on grade separations without ramps and interchanges, as well as additional information regarding at- grade intersection design, the Engineer is referred to the current edition of AASHTO's *A Policy on Geometric Design of Highways and Streets*, and KDOH's *Design Manual and Standard Drawings*.

12.2 General Design Considerations and Objectives for At-Grade Intersections

The main objective of intersection design is to reduce the severity of potential conflicts between vehicles, bicycles, pedestrians, and facilities while facilitating the convenience, ease, and comfort of drivers in making the necessary maneuvers at intersections. Four basic elements enter into design considerations of at-grade intersections:

- **Human Factors**
  - Driving Habits
  - Ability to make decisions
  - Driver expectancy
  - Decision and reaction time
  - Conformance to natural paths of movement
  - Pedestrian use and habits
- **Traffic Considerations**

- Design and actual capacities
- Design-hour turning movements
- Size and operating characteristics of vehicle
- Movements (diverging, merging, weaving, and crossing.)
- Vehicle speed
- Transit involvement
- Accident Experience

- **Physical Elements**

  - Character and use of abutting property
  - Vertical alignments at the intersection
  - Sight distance
  - Angle of intersection
  - Conflict area
  - Speed-change lanes
  - Geometric features
  - Traffic control devices
  - Lighting equipment
  - Safety features
  - Bicycle traffic

- **Economic Factors**

- Cost of improvements
- Effects of controlling or limiting right-of-way on abutting residential or commercial properties where channelization restricts or prohibits vehicular movements
- Energy consumption

12.3 Vertical and Horizontal Alignment of Intersections

Both vertical and horizontal curves should be avoided within an intersection, if at all possible; to reduce the potential problems caused by superelevation, drainage, and sight distance. In addition to grades being as flat as practical, the roads should intersect at 90°, if possible. Intersection angles as small as 80° are acceptable; however, when the intersection angle becomes less than 80°, the Engineer should give consideration to re-alignment of one or both roads. The sight distance should be equal to or greater than the minimum values for specific intersection conditions.

12.4 Turning Radii

As the turning radii are increased, all of the following are also increased: paving costs, intersection area required, distance pedestrians will need to traverse. Additionally, increased turning radii encourage higher turning speeds. Substandard radii result in unnecessary lane encroachment and increased traffic conflict and accident potential. For left and right turns, the following are considered to be reasonable ***minimum*** turning radii:

- **For standard local-local residential street intersections**: 25 feet radius, based on a curb clearance of three (3) feet and without lane encroachment for a typical street width, using the AASHTO design passenger vehicle.

- **For commercial local-local street intersections**: 35 feet radius.

- **For local-collector or collector-collector intersections**: 25 feet radius, based upon a desire to slightly improve maneuverability of a vehicle in entering or leaving a collector.

- **For collector - arterial intersections**: 35 feet radius.

- **For arterial-arterial intersections:** 35 feet radius. However, the radii should be no larger than 55 feet where pedestrian traffic is present and 75 feet for all other intersections.

Vehicle turning templates should be used to verify the adequacy of turning movements in an intersection. Where right-of-way is restricted, the use of either taper curves or three-centered curves, as described in AASHTO's *A Policy on Geometric Design of Highways and Streets* is recommended.

For all turn radii designs stormwater drainage inlets must be designed and placed outside of the turn radius and no type “A” drainage inlets within 100 feet.

12.5 Pedestrian Conflicts

Intersection design must promote the safe and efficient movement of both vehicles and pedestrians. Documentation should consist of:

- The vehicular flow, including percentage and types of trucks,
- Pedestrian movement (i.e., heavy, moderate, light),
- The presence of pedestrian generators (i.e., the downtown area, schools, malls, etc.), and
- The City of Richmond's recommendation.

If the City feels that there is an amount of pedestrian activity that may affect final design of an intersection, the developer shall arrange for counts of the existing pedestrian movements to be made.

Intersections shall be designed to accommodate pedestrians when:

- Pedestrian activity is considered heavy,
- Special conditions (such as a school) exist, and
- The project team determines that the need to accommodate the pedestrian is greater than the concerns for vehicular movement.

However, when conditions indicate that an approach to an intersection will generate heavy traffic volumes and that pedestrian movements will be negligible in comparison to the vehicular volumes, enlarged radii, including free flow movement on right turn lanes may be used. If a decision is made to allow free flowing movements, consideration should be given to discourage pedestrian movements in those locations by relocating sidewalks or, where practicable, adding fences or other blockades to prevent pedestrians from entering the road area. If moderate pedestrian activity exists, but the need to handle vehicular flow is still greater, the left and right turning radii should be designed for the yield condition, but still be enlarged to accommodate the largest vehicle that would regularly be expected to use the intersection.

12.6 Procedure for Design of an At-Grade Intersection

The following procedures are to be used in designing at-grade intersections.

- **Assembling Basic Data**

- **Traffic Analysis**

  The first step in design of an intersection, the developer may be required to conduct traffic counts, if there are no counts available from the Kentucky Transportation Cabinet.

  If the size of the intersection warrants, the Engineer shall then perform a detailed traffic analysis based on the guidelines contained within the *Highway Capacity Manual*. This analysis will determine the lengths of storage lanes required and the type of traffic control device needed.

  Following are general guidelines for the use of left-turn storage lanes on multi-lane and two- lane roads:

  - *Multi-Lane Roads:*

    All projects where the median is 16 feet or more in width, left turn lanes should be designed at the following locations:

    - Existing and proposed street and road intersections
    - All major traffic generators such as schools, churches, shopping centers, etc.

    The geometrics of the storage lane shall be determined by the criteria in AASHTO's *A Policy on Geometric Design of Highways and Streets.*

  - *Two-lane Roads:*

    Left storage lanes on two-lane arterial and collector/connector roads should be considered for each of the traffic conditions listed below:

- *Left Turn DHV Less Than 50* - Channelization is not justified with these volumes unless severe sight distance restrictions and unusual traffic conditions are encountered. In the event that the City of Richmond determines that channelization of an intersection with left turn movements in this category is needed; the justifications for the channelization shall be documented along with the estimated construction and right-of-way costs.

- *Left Turn DHV 50-200* - Channelization at intersections with these left turn volumes is desirable in the event that sight distance is restricted by alignment or grade and the construction of such channelization does not involve large quantities of excavation or borrow, bridge widening, or other expensive items. In the event that high costs are involved in the construction of a channelized intersection in this left turn volume category; justifications along with cost estimates shall be documented.

- *Left Turn DHV Over 200* - Channelization should be provided at intersections with these turning volumes unless otherwise approved by the City of Richmond.

  Before a decision is made to eliminate channelization of an intersection with left turn volumes of more than 50 DHV on the basis of excessive costs; consideration should be given to the volume of traffic opposing the left turn movement. In cases where opposing volume is sufficiently large, a more in-depth study may be warranted. The results of this study could offset, to a certain degree, the high construction cost and justify the channelization of a particular intersection.

- **Site Topography:**

  Sufficient site data should be collected to obtain the following:

- All topography, which should be plotted on either a 1” = 50’ or 1” = 20’ scale, depending on the area involved and the site condition requirements
- Profiles on the intersecting roads
- Property ownership
- Sufficient cross-sections or contours for studying right-of-way damages, sight distances, and potential drainage problems

- **Accident Data:**

  When re-designing an existing intersection, the Engineer shall request accident records from the City of Richmond Division of Police, or the Kentucky State Highway Office, or the KYTC Division of Traffic. These records very often indicate a specific problem area within an intersection, such as inadequate sight distance, etc., which must be addressed in the re-design.

- **Preparing Alternate Studies**

  After assembling the above-described data, the Engineer shall prepare studies of alternate plans for the intersection. The major items that should be included in these studies follow:

  - **Proposed Alignment of the Intersecting Roads**: The Engineer shall carefully study the alignment of any existing intersections to determine if realignment is required. Realignment should definitely be considered if any of the following conditions exist:

    - The intersection angle is less than 80°
    - Excessive horizontal curvature exists
    - Savings in the cost of right-of-way acquisition could be realized by shifting the alignment
    - Intersection sight distance is restricted

  - **Proposed Grades of the Intersecting Roads**: The Engineer shall evaluate grades at existing intersections, and consider modifying existing grades if any of the following conditions occur:

    - Excessively steep grades exist
    - Less than desirable stopping sight distance exists
    - Savings in the cost of right-of-way acquisition could be realized by raising or lowering grades

  - **Proposed Road Crossings with Depressed Medians**: In an effort to reduce the sharp breaks in the profile of roads crossing a proposed road with a depressed median, a procedure has been developed as shown in KDOH's *Standard Drawings* Exhibit 10-01. It allows the grade points on the road having the depressed median to be adjusted to reduce the severity of the breaks at the inside edges of pavement. The use of this procedure on initial and ultimate construction projects shall be decided on a case-by- case basis at the preliminary line and grade inspection.

- **Channelization Details**: Each intersection must be evaluated to determine the need for channelization. Any of the following conditions may warrant channelizing of an intersection:

- High accident frequency
- Dense vehicular traffic
- High-speed vehicular traffic
- Complex intersection
- Wide road
- Difficulty in providing adequate control by standard signs and markings
- Specific warrants cannot be stated. Each location calls for special study.

When the decision is made to channelize an intersection, the design of traffic islands should be as simple as possible. This is to avoid confusing traffic. Each island should have a definite purpose and there should be as few as possible. The City of Richmond's policy is to normally provide only flush islands. Exceptions to this policy may be made in cases where the island is large and may be utilized to shield pedestrians or where placement of special signing or poles may be required. When a decision is made to utilize a raised island, the matter should be discussed at an inspection. Documentation is to be provided as part of the inspection report. If all parties agree that the raised island is acceptable, the island should be designed as a mountable island.

- **Maintenance of Traffic during Construction**: The Engineer shall develop a plan for maintaining traffic during construction for each alternate studied. This plan shall be developed sufficiently to detail traffic lanes that are to be maintained, a general sequence of construction phasing, and any detours or temporary pavement widening which will be required.

- **Right-of-Way Widths**: The Engineer shall exercise great care in the establishment of vertical and horizontal alignments in order to minimize right-of-way damages. In commercially developed areas, right-of-way widths shall be held to a minimum and construction easements utilized where practicable. The Engineer shall make provisions for the replacement of existing entrances, curbs, sidewalks, etc., where possible, in order to minimize damages.

- **Proposed Drainage**: The type of proposed drainage system (storm sewer or open ditch) to be utilized shall be determined. A preliminary size and location shall be specified for all drainage structures larger than a 36” diameter pipe culvert. A careful evaluation shall be made of the effects that proposed realignments and/or grade changes would have on drainage of the intersection.

- **Evaluation of Major Utility Relocations**: All major existing utilities such as water lines, gas lines, sanitary sewers, underground telephone cables, and overhead electric transmission facilities shall be shown on the plans. In many cases, it may be necessary to alter the alignment and/or grade in order to avoid relocation of major utilities.

- **Pedestrian Facilities**: The Engineer shall make a determination of the need for pedestrian facilities such as sidewalks, wheelchair ramps and, in some cases, pedestrian overpass structures.

- **Obtaining Cost Estimates**

  After alternate plans for the intersection have been studied, the Engineer shall select the most feasible alternates and obtain estimated costs for right-of-way acquisition, utility relocation, and construction for each.

- **Submitting the Recommended Alternate**

Signalized intersections, intersections signalized for pedestrians, channelized intersections and intersections on urban projects shall be submitted to the City of Richmond for approval. Submittals shall be after preliminary line and grade and prior to final plans-in-hand inspection. Some intersections (interchanges or complicated intersections) will require a separate geometric layout sheet that should include an approval signature block. Urban projects with multiple intersections may be submitted with a cover letter that includes a listing of the intersections by either name or centerline station and the approval signature block with a copy of the plan and profile sheets of all intersections listed.

The Engineer shall select the preferred alternate for submittal to the City of Richmond Engineer. In cases where there is no clear-cut preferred alternate, it may be necessary to submit several alternates for consideration.

The following data shall be submitted for each plan:

- Plan sheets or sheets detailing channelization, right-of-way widths, drainage, curbs, utilities, etc.
- Profiles
- Traffic Analysis
- Cost Estimates
- A report detailing other plans studied and the reasons they were not adopted
- A stamped original of the geometric layout sheet of the intersection

After Richmond approval, the Engineer shall incorporate the approved design into the final plans and include the approved and signed layout detail sheet.

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Chapter 13
Pavement Design Criteria and Roadway Inspection

13.1 Purpose

The purpose of this chapter is to establish the pavement design standard. These pavement design standards must also fully correspond to the appropriate design standards set forth in other sections of this manual.

It is critical to note that prior to the development of this Roadway Manual, the City of Richmond has experienced premature distress on many of the city's heavily traveled streets. In analyzing this problem, it has become apparent that the city needed to upgrade its pavement design procedure. To that end, there is a need to emphasize in this Manual that the city has set a 20-year life cycle standard for the design of all streets in Richmond. The design standards outlined in this chapter, and throughout this manual, are designed specifically to achieve this goal.

13.2 Performance Serviceability Index and Terminal Serviceability Index

- **Performance Serviceability Index**

  The functional performance of a pavement concerns how well the pavement serves the user. That is to say, what is the riding comfort and riding quality on a particular road? In order to quantify riding comfort, the serviceability-performance concept was developed by AASHTO. Over time, a road's pavement's serviceability and performance serviceability index decrease. The major factors influencing these losses are traffic, age, and environment.

  The serviceability index scale ranges from zero (O) (impassable street) to five (5) (perfect street). Immediately after initial construction, the values that shall be used for the serviceability index are 4.2 for flexible pavement and 4.0 for rigid pavements.

- **Terminal Serviceability Index**

  The terminal serviceability index is the lowest acceptable level before resurfacing or reconstruction becomes necessary. The lowest acceptable level is dependent upon the street's functional class. Table 13-1 presents values that shall be used in Richmond.

Table 13. 1 - Terminal Serviceability Index for Richmond Roadway Classifications

Classification of Roadway	Terminal Serviceability
Arterials (both Major and Minor)	2.5
Collector	2.5
Local Streets	2.0
Alleys	1.0

13.3 Earthwork, Subgrade Preparation, and Soil/Subsurface Investigations

The proper investigation and preparation of subgrade, granular base, and base course are critical in the life of a street's surface course.

- **Definitions**

  The following are the basic definitions upon which this section will build:

- **Subgrade**: The natural soil material upon which the upper roadway layers are constructed.

- **Modified Subgrade**: Layer designed to augment the subgrade strength. This layer is only used when subgrade strength is below a particular level. It consists of chemically altered or compacted subgrade materials, often in combination to achieve certain strength characteristics required in specific conditions. Additionally, modified subgrade acts to reduce frost and water intrusion actions.

- **Granular Base**: Constructed on top of the subgrade. It consists of granular material such as crushed stone or gravel. The specifications for the granular base are more rigorous than that for the subgrade in terms of strength, hardness, gradation, and aggregate types. The granular base layer is placed on the subgrade to support an asphalt base course or a portland cement slab.

- **Pavement**:

  - **Base Course**: The base course is the layer, or layers, of a specified material of designed thickness placed on the granular base. In the case of an asphalt pavement, the base course further serves as a foundation course to support the surface course. In the case of a portland cement pavement, there is only one course of pavement material and the base course and surface course are one and the same.

- **Surface course**: The purpose of the surface course is to accommodate the traffic load, provide a smooth riding surface, resist the wear and tear from traffic, provide skid resistance to vehicles, and prevent excessive water from penetrating into the base course. In the case of asphalt pavement, the surface course of the pavement section consists of a mixture of mineral aggregates and asphalt materials. In the case of a portland cement pavement, there is only one course of pavement material and the base course and surface course are one and the same.

- **Testing Requirements**

Before a new roadway design is undertaken, appropriate testing of the existing soils and future subgrade must be completed. The Engineer shall review soil maps, core graphics, and appropriate site-specific geotechnical data prior to completing the roadway's pavement design.

- **Geotechnical Investigation**

Prior to initiating field work, a boring plan and tabulation of borings shall be developed. The boring plan shall be presented on topographic or site mapping of sufficient scale to accurately depict site conditions. The plan shall show the locations and symbols for all borings proposed for the project. The tabulation of borings shall identify each hole; indicate the type of soil sampling to be performed and the length of rock core to be obtained; show the estimated depths of the borings; and identify any instrumentation, such as groundwater observation wells, to be installed in the borings. It shall be noted that additional subsurface exploration, or modifications of the guidelines presented, may be warranted depending upon site conditions observed and project requirements.

A geotechnical exploration performed for a roadway/street shall provide subsurface data that may be used to evaluate:

- Cut stability sections in soil and rock
- Embankment construction/fill placement
- Embankment stability
- Settlements of embankments
- Subgrade materials to be used for pavement support

Borings shall be performed along the roadway centerline to determine soil types and thicknesses. Soil samples collected from these borings may be subjected to standard engineering classification, water content, moisture-density, and California bearing ratio (CBR) testing (This is not the same test used by the KYTC). These test results shall then be used to design pavements. If significant cuts and fills are planned, then additional borings may be necessary at selected roadway sections to provide data with which evaluations of cut and embankment stabilities may be made.

- **Soil Profile Borings**

Soil profile borings shall be performed at maximum 300-foot spacings along the project alignment through both cut and fill intervals. Typically, these borings shall be drilled along the centerline of the roadway. In an area of embankment construction that will require fill placement greater than 15 feet in height, the profile boring at that section shall be offset from centerline to the point of maximum fill height (the shoulder). Soil profile borings in fill intervals shall be advanced to a depth equal to the proposed fill height or to auger refusal, whichever is less. In areas requiring more than ten feet of excavation to obtain ditch grade, the boring shall be offset to the point of maximum excavation (the ditchline). Soil profile borings in a given cut interval shall be drilled to a depth equal to five feet below the ditch grade of the section on which they are to be drilled, or to auger refusal, whichever is less. Side-hill situations requiring both excavation and embankment construction at a single station may have two borings performed; one in the ditchline of the cut, and one at the fill shoulder.

Bag samples shall be collected for each soil type encountered within each 1,000-foot interval of roadway length. If the soil type collected will be used for fill during construction, then 30-pound samples shall be obtained so that enough soil will be available for appropriate laboratory testing. For roadways/streets less than 1,000-feet in length, a minimum of two bag samples shall be collected, even if only one soil type is visually identified in the borings.

Moisture content samples shall be collected from selected soil profile borings at depth intervals of five feet, and for every change in soil type. These samples consist of soil cuttings generated from the augering process. Moisture content samples shall not be collected from soil cuttings obtained below the water table. When the water table is encountered, other techniques such as thin-walled tube sampling or standard penetration testing shall be used to collect samples for moisture content testing.

Bag samples of the predominant soil types encountered shall be collected from selected soil profile borings to provide specimens for engineering classification,

moisture-density (standard or modified Proctor), and California bearing ratio (CBR) testing. These samples also consist of soil cuttings generated by the augering process. Care should be exercised not to combine different soil types for the same bag sample. **Samples that will be used for a combination of classification, moisture-density, and CBR testing shall be a minimum of 50 pounds.**

- **Cut Stability Borings**

Cut intervals may require rock core borings, rock soundings, sample borings, and/or open face logging to provide sufficient data for cut slope design. **In general, at least one critical cut slope section shall be evaluated for each 500-foot length of roadway cut interval, or fraction thereof, which will exhibit cuts deeper than 15 feet.** Identification of a "critical section" requires engineering judgment and experience. A critical cut section is typically one that exhibits the deepest proposed excavation, and/or will expose complicated geologic conditions.

Rock core borings shall be located such that core samples from the entire geologic column, from the highest point in the cut interval to five feet below the lowest point of the ditch in the cut interval, are retrieved. Cuts in steep side-hill situations may require more than one rock core boring per critical section to provide sufficient data for design of the cut slope. The first core boring shall be drilled in the ditchline, and the second boring drilled near the top of the proposed cut slope. Where more than one rock core boring is required to represent the entire geologic column in a cut interval, the rock recovered from the borings shall overlap a minimum of 10 feet, by elevation, in both cross section and profile views. If bedrock is not encountered within 10 feet of the ground surface in the rock core boring of a critical cut section, a sample boring shall be performed a minimum of 20 feet upslope and perpendicular to centerline from the rock core boring. An observation well shall be installed in this additional boring to monitor groundwater levels if the soil depth at this location exceeds 5 feet. To further identify soil depths within a cut interval, rock soundings shall be performed in the ditchline at approximate intervals of 100 feet. Such soundings shall be drilled to auger refusal or to a depth of five feet below the ditchline, whichever is less.

- **Embankment Stability Borings**

Embankment stability borings shall be performed for proposed critical embankment sections that are greater than 20 feet in height from toe to crest. In general, at least one critical embankment section shall be evaluated for each 1,000-foot length of fill interval, or fraction thereof. A critical embankment section may be identified as the cross section exhibiting the tallest or least stable embankment configuration within the fill interval. Assessment of the plans and cross-sections to select critical sections requires engineering judgment and experience. Embankment stability borings shall consist of sample borings and/or soil profile borings drilled to a depth equal to twice the height of the proposed embankment or to bedrock, whichever is less. Two borings shall be performed for each critical section; one at the point of highest fill placement (the shoulder), and one boring near the toe of the proposed slope. When soil thicknesses exceed 5 feet in a sample boring drilled for evaluation of embankment stability, a groundwater observation well shall be installed prior to backfilling. Observation well readings shall be performed periodically to provide groundwater data to use in subsequent embankment stability analyses.

- **Subgrade Analysis**

The majority of pavements constructed in Kentucky are constructed on fine-grained soils. Approximately 85% of the soils consist of clay and silt. When first compacted, these fine- grained soils usually have sizable bearing strength. If pavements are constructed immediately after compaction of fine-grained soils, then major problems typically will not be encountered when placing and compacting layers of paving materials. Problems arise, however, when surface and subsurface water penetrates compacted fine-grained soils. Water from rainfall, snowmelt, and groundwater seepage enters the fine-grained soils subgrade, causing swelling and producing a loss of bearing capacity in the subgrade. The most susceptible, adverse period occurs when a fine-grained soil subgrade is exposed to the wetting conditions of winter and early spring.

Because the subgrade's type and condition is so critical to the final life expectancy of a street, proper geotechnical analysis must be completed. In particular, this testing will include a California Bearing Ratio (CBR) calculation for the soils. It is noted that all soils with a California Bearing Ratio (CBR) of less than four (4), using the ASTM Method, will require soil stabilization.

- **Subgrade Preparation**

Due to the likelihood for void development, granular base construction directly on a weak natural soil is not permitted. All streets shall be constructed on a compacted or stabilized subgrade. The subgrade is to consist of manually compacted soil or it shall be chemically stabilized.

Methods for mechanical stabilization of subgrade soils include the following approaches:

- Controlling subgrade density-moisture
- Undercutting poor materials and backfilling with granular materials

- o Proof rolling and re-rolling of the subgrade
- o Using granular layers
- o Using granular layers reinforced with geofabrics

Commercially available chemical stabilizers include hydrated lime and portland cement. Both have been demonstrated to be effective in stabilizing subgrade soils as stable paving platforms and are believed to contribute to reducing fatigue and extending the life of pavement structures. Portland cement has been demonstrated to be most suitable for stabilizing more granular, course grained subgrades. Hydrated lime has been demonstrated to be most suitable for stabilizing fine- grained soils with high clay content.

- **Granular Base and Pavement Design**

The Engineer shall design the dense granular base (DGA) and pavement thicknesses using the procedures in the AASHTO Pavement Design Guide. The Engineer shall compare the results of the pavement design to the thicknesses in Table 13.2. In no case shall the thickness of the base and asphalt/portland cement course be less than those shown in Table 13.2. Concrete paving shall be Class A as defined by the KYTC.

Table 13. 2 - Minimum Thickness Standards for Granular Base and Pavement Courses

Street Classification	**Thickness (Inches)**	
	Asphalt Surface Course/ Asphalt Base Course/ Dense Granular Base	**Portland Cement Single Course/Dense Granular Base**
Arterials and non-residential streets (all classifications)	1 / 6 / 9	8 / 4
Residential collector streets (urban and rural)	1 / 6 / 8	7 / 4
Residential local streets (urban And rural)	1 / 3 / 9	6 / 4
Note: “Full depth” asphalt concrete pavements are not permitted in the City of Richmond. Asphalt pavements must be constructed on a proper depth of granular base.		

The City of Richmond may also approve experimental materials for limited use. It is the responsibility of the design Engineer intending to use these materials that must demonstrate their effectiveness and required structure thickness.

13.4 Pavement Design Procedures

The procedures for designing flexible pavement are listed below:

- For a residential street, estimate the number of houses that will be served by the street. For a loop/cul-de-sac, it will equal the number of houses on that street. For a continuing street, it will equal the number of houses that will use the street when entering/leaving the subdivision.

- For a street that will serve industrial or commercial property, estimate the gross floor area for the development. For hotels and motels, estimate the number of rooms.

- Determine the number of Equivalent Single Axle Loads (ESALs) from Table 13.5 for residential streets, and from Table 13.6 for commercial/industrial streets.

- Based on the CBR, determine the required Structural Number from Table 13.7. The minimum structural number shall be 2.84 for residential streets, 4.04 for collector streets, and 4.16 for arterial streets.

- Determine the required thickness of asphalt, the dense granular base (DGA), and No. 2 stone to achieve the required Structural Number. The layer coefficients are listed below:

    - Asphalt – 0.44
    - DGA – 0.12
    - No. 2 Stone – 0.08

Following are the minimum thicknesses for asphalt and DGA.

Table 13.3 – Minimum Thickness for Asphalt and DGA

Street Classification	Asphalt	DGA
Residential Local	4”	9”
Residential Collector	7”	8”
Arterial/Non Residential	7”	9”

From November 1 to March 1, a “winter design” may be used with the following minimum thicknesses. A filter fabric shall be placed between the No. 2 stone and the subgrade when using the winter design.

Table 13.4 – Winter Design for Minimum Thickness for Asphalt and DGA

Street Classification	Asphalt	DGA	No. 2 Stone
Residential Local	4”	4.5”	As required to meet SN
Residential Collector	7”	4.0”	As required to meet SN
Arterial/Non	7”	4.5”	As required to meet SN

- If unstable areas are discovered during the proof roll test, then stabilize the area by removing 4 to 8 inches of the unstable material and replacing it with No. 2 stone. No. 2 stone used to make up the structural number shall be separated from the subgrade by filter fabric. Stabilization is required when the soil subgrade pumps during the proof roll test. A CBR less than 4 does not automatically mean the subgrade is unstable.

Table 13. 5 - Equivalent Single Axle Loads for Residential Streets

Number of Houses Served By the Street	Equivalent Single Axle Loads				
	Construction Trucks	**Moving Vans**	**Garbage Trucks**	**School Buses**	**Total**
0	0	0	6240	12000	18240
20	600	240	6240	12000	19080
40	1	480	6240	12000	19920
60	1	720	6240	12000	20760
80	2	960	6240	12000	21600
100	3	1200	6240	12000	22440
120	3	1440	6240	12000	23280
140	4	1680	6240	12000	24120
160	4	1920	6240	12000	24960
180	5	2160	6240	12000	25800
200	6	2400	6240	12000	26640
220	6	2640	6240	12000	27480
240	7	2880	6240	12000	28320
260	7	3120	6240	12000	29160
280	8	3360	6240	12000	30000
300	9	3600	6240	12000	30840
320	9	3840	6240	12000	31680
340	1	4080	6240	12000	32520
360	1	4320	6240	12000	33360
380	1	4560	6240	12000	34200
400	1	4800	6240	12000	35040

Notes:

Number of Houses Served By the Street – For a loop/cul-de-sac, it will equal the number of houses on that street. For a continuing local street or a collector, it will equal the total number of houses that will use the street when entering/leaving the subdivision.

Construction Trucks – Based on 20 loaded supply trucks per house and 1.5 ESALs per truck, for a total of 30 ESALs per house.

Moving Vans – Based on each house selling 4 times in 20 years and each transaction involving one loaded moving van for the seller and buyer, for a total of 8 trucks per house. It assumes 1.5 ESALs per truck for a total of 12 ESALs per house.

Garbage Trucks – Based on the following for a 20-year design life:

- 2 garbage trucks/street/wk x 52 wks/yr x 20 yrs x 1.5 ESALs/truck = 3120 ESALs
- 1 recycling truck/street/wk x 52 wks/yr x 20 yrs x 1.5 ESALs/truck = 1560 ESALs
- 1 yard waste recycling truck/street/wk x 52 wks/yr x 20 yrs x 1.5 ESALs/truck = 1560 ESALs Total of above = 6240 ESALs per street for garbage trucks
- School Buses – Based on the following for a 20-year design life:
- 2 school buses/day/street x 200 days/yr x 20 yrs x 1.5 ESALs/truck = 12,000 ESALs per street

Table 13.6 - 20-Year ESALs for Various Industrial and Commercial Developments

	Gross Floor Area (Sq. Ft.) x 1000											
Land Use	**1**	**5**	**10**	**20**	**40**	**60**	**80**	**100**	**200**	**300**	**500**	**1,000**
General Light Industrial (15% Trucks)	80,000	115,000	159,000	246,000	418,000	586,000	752,000	915,000	1,681,000	2,370,000	3,515,000	5,020,000
General Heavy Industrial (20% Trucks)	3,000	16,000	31,000	63,000	126,000	188,000	251,000	314,000	628,000	942,000	1,570,000	3,141,000
Warehousing (25% Trucks)	32,000	123,000	219,000	389,000	692,000	968,000	1,229,000	1,479,000	2,629,000	3,681,000	5,623,000	9,994,000
General Office Building (2% Trucks)	1,000	8,000	17,000	35,000	70,000	105,000	141,000	176,000	354,000	531,000	885,000	1,771,000
Retail <200,000 Sq. Ft. (2% Trucks)	21,000	102,000	201,000	393,000	745,000	1,056,000	1,327,000	1,557,000	2,100,000			
Retail >200,000 Sq. Ft. (2% Trucks)										2,840,000	3,923,000	6,630,000

	Number of Rooms							
Land Use	**10**	**50**	**100**	**200**	**400**	**600**	**800**	**1,000**
Hotel (1% Trucks)	3,000	38,000	83,000	171,000	348,000	525,000	702,000	879,000
Motel (1% Trucks)	8,000	47,000	99,000	207,000	433,000	667,000	906,000	1,149,000

Notes:

1. Number of trips generated for each type of development calculated from the Manual of Trip Generation published by the Institute of Transportation Engineers.
2. ESALs calculated by the computer program *PAS 5*developed by the American Concrete Pavement Association.
3. Trucks were assumed to be 50% C5As (TYPE 9) and 50% SU3As (TYPE 6).
4. Loaded Type 9s were assumed to weigh 80,000 pounds. Empty or nearly empty Type 9s were assumed to weigh 50,000 pounds.
5. Loaded Type 6s were assumed to weigh 46,000 pounds. Empty or nearly empty Type 6s were assumed to weigh 30,000 pounds.
6. 50% of both Type 9s and Type 6s were assumed to be empty.
7. The numbers in the table have been rounded to the nearest 1000.

Table 13.7 – Structural Numbers

	Structural Number						
ESALs	**CBR 1**	**CBR 2**	**CBR 3**	**CBR 4**	**CBR 5**	**CBR 6**	**CBR 7**
1,000	2.15	1.65	1.39	1.23	1.09	1.01	1.00
2,000	2.38	1.84	1.58	1.39	1.27	1.17	1.08
3,000	2.54	1.97	1.69	1.50	1.36	1.26	1.17
4,000	2.65	2.07	1.77	1.58	1.44	1.33	1.24
5,000	2.74	2.14	1.84	1.64	1.50	1.39	1.30
6,000	2.81	2.20	1.89	1.69	1.55	1.43	1.34
7,000	2.88	2.26	1.94	1.74	1.59	1.47	1.38
8,000	2.94	2.31	1.99	1.78	1.63	1.51	1.42
9,000	2.99	2.35	2.02	1.81	1.66	1.54	1.45
10,000	3.03	2.39	2.06	1.85	1.69	1.57	1.47
20,000	3.35	2.65	2.30	2.07	1.90	1.77	1.67
30,000	3.55	2.82	2.44	2.20	2.03	1.89	1.79
40,000	3.70	2.94	2.55	2.31	2.13	1.99	1.87
50,000	3.81	3.03	2.64	2.39	2.20	2.06	1.94
60,000	3.91	3.12	2.71	2.45	2.27	2.12	2.00
70,000	3.99	3.19	2.78	2.51	2.32	2.17	2.05
80,000	4.07	3.25	2.83	2.56	2.37	2.22	2.10
90,000	4.13	3.30	2.88	2.61	2.41	2.26	2.14
100,000	4.19	3.35	2.93	2.65	2.45	2.30	2.17
200,000	4.60	3.70	3.24	2.94	2.72	2.55	2.42
300,000	4.86	3.91	3.43	3.12	2.89	2.71	2.57
400,000	5.04	4.07	3.57	3.25	3.01	2.83	2.69
500,000	5.19	4.19	3.68	3.35	3.11	2.93	2.78
600,000	5.31	4.30	3.78	3.44	3.20	3.01	2.85
700,000	5.42	4.39	3.86	3.52	3.27	3.08	2.92
800,000	5.51	4.47	3.93	3.58	3.33	3.13	2.98
900,000	5.60	4.54	4.00	3.64	3.39	3.19	3.03
1,000,000	5.67	4.60	4.06	3.70	3.44	3.24	3.07
2,000,000	6.19	5.04	4.45	4.07	3.79	3.57	3.40
3,000,000	6.51	5.31	4.70	4.30	4.01	3.78	3.60
4,000,000	6.75	5.51	4.88	4.47	4.17	3.93	3.74
5,000,000	6.93	5.67	5.03	4.60	4.30	4.06	3.86
7,000,000	7.23	5.92	5.25	4.81	4.49	4.25	4.04
10,000,000	7.55	6.19	5.50	5.04	4.71	4.45	4.24

13.5 State and Federal Highways

All streets and rural roadways in Richmond designated as State or Federal Highways must be designed in accordance with the design requirements approved by the Kentucky Department of Highways.

13.6 Pavement Design Requirements for Developments in Phases

For new developments being completed in phases, several special street design requirements apply.

- **Delay in the Application of the Asphalt Surface Course**

  The final 1-inch surface course of asphalt shall be applied after all the primary services of utilities have been installed, and in accordance with the following requirements:

  - The final surface course shall be applied within three (3) years of the construction of the original street.
  - The initial base course of asphalt concrete shall be designed such that this layer alone shall provide the required structural strength for the road's first three (3) years of usage.

- **"True Use" Design Standards**

  For developments that are designed in phases, streets shall be designed to reflect the usage they will experience over the first three years of the street's life. Therefore, if a street will be a primary access route for construction traffic during a subdivision's site development, this street shall be designed to meet the industrial/commercial street standards, to reflect it's true usage in the first three years of its existence, verses being designed to reflect its eventual usage as a residential street. This standard is required to prevent the premature damaging of the street's pavement and granular base, and to ensure that the 20-year life cycle for Richmond's streets is achievable.

13.7 Curb/Gutter Design and Storm Drainage Capacity Requirements

Curbs and gutters are required for all new streets in Richmond and shall be designed in accordance with the KYTC standards for design of drainage facilities.

13.8 Grading and Embankments

The area on which streets and embankments are to be constructed shall be cleared of all vegetation for a depth of at least three (3) inches and the material removed shall be disposed of outside of the limits of the typical section. Prior to construction of embankments, any unsuitable material on which the embankment will be super-imposed shall be removed and the area stabilized by conventional methods. The embankments shall be formed by placing material in successive horizontal layers of not more than twelve (12) inches in thickness (loose depth). Each layer shall be thoroughly compacted by rolling with a ten-ton three wheel roller, sheep's foot roller, or other approved roller.

13.9 Cut Section Elevation

Cut sections shall be excavated to the required typical section and any unsuitable material encountered shall be removed and the area backfilled in six (6) inch horizontal layers and thoroughly compacted before successive layers are placed.

13.10 Solid Rock Excavation

If solid rock is encountered during the grading operation, the solid rock shall be removed to a depth of six (6) inches below sub-grade elevation and backfilled to meet the requirements above.

13.11 Repair of Utility Crossings

When pipe or other underground construction takes place within existing streets and roads, the streets must be reconstructed to meet current design standards. Restoration of pavement will be completed based on the type of existing roadway material, i.e., concrete or asphalt pavement. The type of trench restoration, whether flowable fill material or conventional stone backfill, will be determined by the City of Richmond. Standard Drawings of the pavement repairs are included in Appendix C, at the end of this manual.

13.12 Bituminous Pavement Construction and Inspection

The quality of bituminous pavement construction is an important phase of construction that reflects directly on Richmond's public image. Problems that arise because of poor quality bituminous pavement construction, however, remain visible and may serve as a constant source of complaints long after a project is finished.

On infrastructure construction projects the following basic objectives in bituminous pavement construction are:

- Support traffic loads;
- Protect subgrade, subbase, and/or base from surface water;
- Minimize loss of surface material;
- Provide a reasonable surface texture;
- Provide flexibility for subbase deflections; and
- Provide resistance to weathering.

These basic objectives shall have been incorporated into the design of the pavement sections or repair efforts. One of the Inspector's primary tasks is to understand how field observations of actual construction conditions may affect these basic objectives of road construction and to relay any concerns to the Engineer.

Prior to construction of new pavements or the repair/resurfacing of existing pavements, the Inspector shall have a thorough understanding of Contract Documents, the geotechnical report, this manual, and the individual components of the pavement section. In some instances, the project specifications may dictate the use of lime stabilization or cement modification (or other means) to stabilize bearing materials. In these instances, the Inspector shall obtain the appropriate construction specifications, product data, or reference materials and become familiar with the particular job requirements. At other times, the Contract Documents may place logistics constraints on the Contractor (i.e. the Contractor may be required to pave certain areas before others, etc.). The Inspector shall observe the Contractor operations and notify the Engineer when these constraints are not being met.

The Contract Documents may require the Contractor to submit material certifications, aggregate sieve analyses, and bituminous pavement mix formulas. Prior to construction, the Inspector shall verify that the appropriate submittals have been made and approvals received. The status of contractor submittals, inspector observations and field test results shall be documented.

13.13 Inspection of New Pavements

New pavements are typically comprised of four components. The prepared roadway bed is typically called the subgrade. The subgrade may consist of natural soils or an approved soil fill. In some instances, the uppermost surface (6-18 inches) of the subgrade is modified to improve bearing characteristics and increase stability. This modified or improved zone of the subgrade is sometimes called the subbase. The subbase may also consist of select materials, such as natural gravels or merely select borrow material. The granular base course typically overlies the subgrade (and subbase) and generally consists of dense-graded aggregate (DGA). The granular base is followed by a mixture of asphalt and coarse-grained aggregate called the asphalt base course. The final (top) component of the bituminous pavement section is the asphalt surface course, which is generally thinner than the underlying base course, contains smaller aggregates, and more bitumen.

The thickness and composition of the pavement section is typically based on an engineering design utilizing the site-specific soils. Soil samples are normally collected during the geotechnical exploration of the site and are subjected to tests that indicate their acceptability for bearing materials. A typical test to indicate acceptability of bearing medium is the California Bearing Ratio (CBR) (ASTM D 1883) test. Unfortunately, in Madison County, many of the residual soils have high clay contents and are poor bearing media, (i.e., low CBR). High clay contents typically mean poor drainage characteristics and low long-term strengths. Consequently, many pavement designs in the Madison County area incorporate the use of subgrade modifications such as additions of cement or lime, biaxial geogrids, filter fabric or aggregate subbases. Pavement sections may also incorporate means to improve natural drainage characteristics such as piping networks or the addition of open-graded subbases. The Inspector shall be familiar with the descriptions of soils utilized in the pavement design, and have a basic understanding of the drainage requirements so that he/she is able to identify changed subgrade and drainage conditions and bring them to the attention of the Engineer.

- **Subgrade**

  Several items shall be verified by the Inspector prior to establishing subgrade competency. These items include:

  - Verify that any bedrock identified at the subgrade level has been undercut to the depth specified in the Contract Documents.
  - Verify that utilities which traverse the roadway alignment have been installed,
  - Verify that the subgrade is free from ruts, large stones, and excessive dust,
  - Verify that the subgrade elevation is correct according to the cross-sections and alignment, and
  - Request a subgrade proof-roll test.

  Regarding the above items, any noteworthy observations shall be brought to the attention of the Engineer. These verifications will help reduce the amount of interruptions in the paving operations and future discontinuities in the pavement surface. Regarding the last item, the Inspector shall request that the roadway subgrade be subjected to a subgrade proof-roll test so that soft, wet, or pumping areas may be identified. The minimum total weight of the loaded dump truck shall be 37 tons. The truck shall be operated at walking speed over the entire subgrade.

Any excessive deflections such as rutting or pumping may require stabilization measures and shall be brought to the attention of the Engineer. The Inspector shall observe the operations to verify correct speed and ensure all areas of the subgrade are covered.

Typical treatments of soft or wet areas of the pavement subgrade include removal and replacement (undercutting), “working-in” No. 2 stone, or installation of a geogrid/geotextile system and crushed stone. The extents and performance requirements of such improvements shall be set forth in the Contract Documents or as directed by the Engineer.

Other means to stabilize the subgrade are available. Lime stabilization or cement modification (KTC Section 304) may be required and the Inspector shall become familiar with the requirements in the Contract Documents for each. On projects that require these special treatments, the Inspector shall consult with the Engineer to obtain a revised Proctor curve(s), compaction requirements, and construction operations to be utilized. The Inspector shall be aware that changes in soil subgrade conditions (material types, moisture conditions, etc.) may have a direct influence on the type and extent of stabilization/modification being utilized and he/she shall stay in close contact with the Engineer. Any deviations from the Inspector's understanding of the required soil conditions, compaction requirements, application rates or construction operations and procedures shall immediately be reported to the Engineer.

The pavement subgrade shall be compacted to a uniform density throughout according to the requirements of the Contract Documents. If the density of the subgrade has been diminished by exposure to weather, after having been previously compacted, it shall be recompacted to the required density and moisture content.

Observations made shall be reported on the Pavement Subgrade Inspection Form. At the completion of subgrade verification and preparation operations, the Contract Documents may require the installation of subgrade drainage systems or perforated pipe underdrains. *Refer to KYTC standards for installation of perforated pipe.*

- ***Subbase***

Subbases, if required by the Contract Documents, may consist of select materials, such as natural gravels, that are stable but that have characteristics that make them not completely suitable as granular base courses. Subbases may also be of stabilized soil or merely select borrow. The purpose of a subbase is to permit the building of relatively thick pavements at low costs. Thus, the quality of subbases can vary within wide limits, as long as the thickness and material requirements set forth in the Contract Documents are fulfilled. Because subbases may consist of a variety of material types and consistencies, they can be grouped according to the nature of quality control procedures that shall be implemented during placement. Typical groupings utilized in the Contract Documents are "Soils" and "Aggregates.”

Select borrow soils are typically placed in an engineered fashion to a specified density and within a certain percentage of optimum moisture content. The Inspector shall verify that the necessary soil samples have been obtained and that the proper tests have been performed. The Inspector shall assist the Contractor with obtaining representative samples from the proposed borrow area(s). Further, the Inspector shall review the results of the testing to ensure that the soils fulfill the requirements of the Contract Documents. Such information may include a complete soil classification (ASTM D 2487), CBR, and Proctor moisture-density relationship (ASTM D 698 or ASTM D 1557). The soils shall be placed in accordance with the Contract Documents that usually include a maximum loose lift thickness of 8 inches and a compacted density of 95 percent of the standard Proctor maximum dry density.

Aggregate materials utilized as subbase shall be placed in accordance with the Contract Documents. Aggregates with a small percentage of fines are typically bladed in place and tamped to minimize voids and bridging. Aggregates with a greater percentage of fines, such as dense-graded aggregate (DGA), are typically compacted to a certain percentage (usually 84 percent) of the solid volume density determined from the oven-dry bulk-specific gravity (KM 64-607).

If the top surface of the subgrade has been modified with the application of cement or stabilized with lime, the Engineer or Contract Documents may treat this zone as a subbase. In any case, the precautions and items to observe for such improvements are noted in the previous section. The Inspector shall also be aware that the pavement section may also include aggregate-geogrid or aggregate-geotextile layers. The Inspector shall become familiar with the construction techniques discussed in the Contract Documents as well as their testing requirements. Under all circumstances, the Inspector shall verify that construction materials, specified depths or thicknesses and construction practices are implemented in the field as specified in the Contract Documents. Any deviations shall be brought to the attention of the Engineer.

- ***Granular Base Course***

The granular base course, unless stated otherwise in the Contract Documents, shall consist of compacted dense-graded aggregate (DGA) meeting the requirements set forth in Section 805 of the Kentucky Transportation Cabinet's (KTC) Standard Specifications for Bridge and Road Construction. The Contract Documents may require that the DGA be obtained from a previously approved source. If the DGA source has not previously been approved, the Contractor may be required to submit results of physical tests performed on the material to verify that it meets the requirements referenced above. The Inspector shall assist the Contractor in obtaining a representative sample and in its care and handling.

The DGA shall be applied in thicknesses specified in the Contract Documents. Typically, these lifts are no less than 3 inches and no more than 6 inches in thickness. Each lift of DGA shall be compacted to a density specified in the Contract Documents that is generally no less than 84 percent of the solid volume density based on the oven-dry bulk specific gravity as determined by KM 64-607. A typical minimum frequency for field density testing of DGA placement is one test per 2,000 square feet with a minimum of one test per shift during which DGA is placed. The DGA shall be compacted using a vibratory roller or vibratory plate.

In addition to the previously stated guidelines for compaction equipment and lift thickness, the Inspector shall pay close attention to the moisture content of the DGA base during placement and compaction. Before arriving at the site, the DGA shall be adequately mixed with water in a pugmill. During transportation and storage on site, the DGA shall be covered to prevent loss of moisture. DGA shall not be stored or stockpiled at the site unless otherwise provided for in the Contract Documents. If drying of the DGA occurs, the Contractor shall add water to the DGA and shall thoroughly mix the material prior to its placement. A moisture content value between five and seven percent at the time of compaction is typically adequate for the placement of limestone DGA.

- ***Asphalt Base and Surface Courses***

An asphalt base course is an intermediate asphalt course placed between a granular base course and an asphalt surface course. The surface course represents the top portion of the asphalt pavement. These asphalt mixes consist of well-graded aggregate and asphalt cement. The aggregate gradation of the base is typically coarser than that of the surface mix. In addition, in a typical mix, the asphalt content will range from 4 to 8 percent, by weight. The aggregate gradation and asphalt content requirements shall be specified in the Contract Documents. The Inspector shall compare test results and certifications submitted by the Contractor with the requirements to ensure compliance.

The requirements of the equipment used to spread and compact bituminous pavement shall meet the requirements of the Contract Documents. The paver must spread the mixture without tearing the surface and must strike a finish that is true to the required cross section, uniform in density and texture, and free of irregularities. The speed of the paver shall be adjusted as necessary to that speed which provides the best result for the type of mixture being placed. The Inspector shall observe each course immediately after striking off and before rolling for irregularities that require correction. Fat sandy droppings shall be removed and fat areas shall be removed and replaced with satisfactory material. Any portion of the pavement course that is defective or that shows excessive segregation shall be removed and replaced with suitable material.

Well-proportioned asphalt mixes compact readily if spread and rolled at proper temperatures. Compaction requirements vary widely from project to project and consequently, the Contract Documents shall be referenced in this regard. Rolling shall start immediately after the material has been spread by the paver, provided undue lateral movement does not take place under the roller. If rolling causes displacement of the material, the affected areas shall be loosened at once with an asphalt rake and restored to the original grade with loose material before re-rolling. Rolling shall be done with care to prevent undue roughening of the pavement surface.

Rolling of a longitudinal joint shall be done immediately behind the paving operation. The initial, or breakdown, pass with the roller shall be made as soon as it is possible to roll the mixture without cracking the mat or having the mix picked up on the roller wheels. The second, or intermediate, rolling shall follow the breakdown rolling as closely as possible and shall be done while the paving mix is still at a temperature that will result in maximum density. The finish rolling shall be done while the material is still workable enough for removal of roller marks.

Roller wheels shall be kept moist during compaction, with only enough water to prevent the wheels from picking up the asphalt mixture. Rollers shall move at a slow but uniform speed generally with the drive roller or wheels nearest the paver. The line of rolling shall not be suddenly changed or the direction of the roller suddenly reversed.

The pavement course thicknesses and construction tolerances shall be specified in the Contract Documents. The surface of each course shall be checked with templates, straightedges, and/or stringlines for uniformity. These checks can be made by the Contractor in the presence of the Inspector. All irregularities exceeding the allowable tolerances must be repaired as required by the Contract Documents or as directed by the Engineer. The Inspector must note all checks and measurements made of pavement surface uniformity in the Daily Field Report and report any repairs made.

- ***Tack Coat***

The purpose of the tack coat is to increase the bond between old and new surfaces. It may be required on new pavements between the binder and surface courses or on repair of existing pavements. If the tack coat is too heavy, the tack coat may act as a lubricant between the two surfaces, causing the mat to slip when rolled. If the tack coat is not adequate, the mat will not bond to the underlying course properly and may slip under the roller, causing waving or cracking of the mat being placed. In either case, subsequent raveling will occur and eventually a deterioration of the surface will develop.

Unless otherwise stated in the Contract Documents, the tack coat shall be type SS-1h. Prior to applying the tack coat, the area to receive pavement shall be cleaned. The tack coat shall be applied well in advance of the paving operation to allow all water to evaporate before the surface course is placed. This chemical process is termed "breaking" or "setting." One way to determine when the material has set is that its color will change to dark brown within a short time after application, with the exact length of time depending on the ambient and pavement temperatures. Work shall be planned so that no more tack coat than is necessary for the day's operation is placed on the surface. Existing traffic and weather conditions may curtail the distance tack can be placed ahead of the paving operation.

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Chapter 14
Bicycle Routes, Shared-Use Paths, and Pedestrian Walkways

14.1 Purpose

The purpose of this chapter is to establish the minimum and preferred design standards for sidewalks, other pedestrian facilities, and bicycle facilities. The outlined standards in this chapter include both minimum and preferred design standards with clarifications regarding when it is appropriate to apply the range of standards presented.

14.2 Pedestrian Sidewalks

Pedestrian walkways are required on both sides of all roads in the City of Richmond, unless a type of street is specifically exempted or a special exception is granted by the city. Most pedestrian walkways are generally equivalent to the traditional sidewalk model, however this manual allows for innovative walkway designs, such as a shared-use path. Both traditional sidewalks and these alternative designs are discussed further in this section.

In today's subdivisions, sidewalks have the following functions:

- Provision for maximum safety of children playing on their block
- Protection of children walking to and from schools, neighbors, and parks
- Provision for adults to walk to and from parks, neighborhood shopping, and transit stops
- Provide safe travel pathways for handicapped individuals

- **Conventional Sidewalk Design**

o General Requirements: Sidewalks should be constructed in accordance with the City of Richmond Standards and Specifications and in accordance with applicable provisions of the Americans with Disabilities Act.

Sidewalk design considerations must include:

- Providing a roughened surface to ensure proper traction
- Establishing a maximum grade consistent with local conditions, with an absolute maximum grade set at 1:12
- Providing a lateral draining slope of 2 percent

- Providing curb cuts that comply with the Americans with Disabilities Act Accessibility Guidelines

- **Standard Alignment/Typical Cross Section**: Sidewalks must be constructed between the curb line and the right-of-way limit/line. The standard alignments for sidewalks are listed below in the following table.

Table 14. 1 – Standard Sidewalk Alignments/Typical Cross Section

Street Classification:	**Widths (Ft)**	
	Distance from Roadway	**Width of Sidewalk**
Non-Residential and Industrial Collector (40’ street width)	11	4
Non-Residential and Industrial Collector (51’ street width)	6	4
Residential collector streets and industrial locals	6	4
Local residential streets	6-9.5	4
Local residential cul-de-sac streets	6-7.5	4

If the available right of way between the curb and adjacent property line is of insufficient size to accommodate the requirements of this section, alternative designs of the sidewalk may be constructed with the approval of the City of Richmond. It should be noted that the absence of curbs and gutters on a street is not sufficient justification for the elimination of sidewalks.

When right-of-way restrictions and lack of yard easement necessitate a sidewalk next to the curb, and additional 2 feet of sidewalk width is required.

- **Special Alignments with Standard Sidewalks**: Depending on utility placement, a meandering sidewalk alignment within the border area may be considered. Such an alignment is more visually appealing and may save trees or other major plantings, avoid rock outcroppings, etc. However, this should not be used as a justification for locating long sections of sidewalk near the edge of the street.

- **Bridges**: Where sidewalks are required on bridges, they shall be a minimum width of six (6) feet of "barrier free" space.

- **Curb Ramp Guidelines**

  Sidewalks constructed to the requirements herein shall include a curb ramp wherever an accessible route crosses a curb. Curb ramps shall be designed and constructed in accordance with this manual and as required by the American with Disabilities Act (ADA). If there are cases of conflict, ADA standards shall apply. Work within the right-of-way shall be constructed in accordance with the details shown on the plans

  The following curb ramp specifications are established for Richmond:

  - Curb ramps shall be located so that they are not obstructed by parked vehicles and shall not intrude into vehicular traffic lanes.

  - The least possible slope shall be used for any curb ramp. Curb ramp shall not exceed a 1:12 rise to horizontal run ratio. Curb ramp wings not exceed a 1:10 rise to horizontal run ratio. If space limitations prohibit the use of a 1:12 slope or less, a flat landing 48 inches deep and as wide as the ramp area must be located at the top of each curb ramp. In existing right-of-way or street locations where each existing property lines do not allow for this 48-inch deep landing the wings or flared sides of the ramp must have a slope of 1:12 maximum.

  - Sloped surfaces shall be stable, firm, and slip-resistant. Ramp surface may need a detectable warning surface system integral to the walking surface.

  - The minimum width of the curb ramp shall be 48 inches exclusive of flared sides or wings. On existing sidewalks only, where 48 inches is not feasible, a minimum width of 36 inches, exclusive of flared sides or wings shall be allowed. If a curb ramp is located where pedestrians must walk across the ramp, or where handrails or guardrails do not protect it, it shall have flared sides. Curb ramps with returned curbs may be used where pedestrians would not normally walk across the ramp.

- Curb ramps shall be located so as to provide a continuous accessible path of travel.

- **Non-conventional Sidewalks**

With the approval of the Richmond Planning Commission, an alternative sidewalk design (such as a shared-use path) may be substituted for a conventional sidewalk, provided that maintenance and public access agreements are provided and that the alternative design is accessible to persons with disabilities as defined and required in the Americans With Disabilities Act.

- **Meandering Sidewalks**: Meandering sidewalks may be used in order to avoid trees or other natural features, provided that sufficient right-of-way is dedicated to accommodate them.

- **Paved Trails**: In some residential areas, a paved trail may be used in lieu of or in addition to the conventional sidewalk. Sidewalks are typically adjacent and parallel to streets, whereas paved trails meander along natural pedestrian circulation routes.

- **Mid-block access trails**: Mid-block access trails are an appropriate non-conventional sidewalk design. These pedestrian-ways usually run between two houses along a right-of-way established solely for pedestrian traffic. Because of their proximity to houses, special consideration to a resident's privacy should be taken into account.

14.3 Bicycle Compatible Facilities Construction

This section is designed to outline the criteria necessary to successfully accommodate bicycle compatible facilities. There are five types of bicycle facilities to be discussed: 1) shared roadways, 2) signed shared roadways, 3) bike lanes, 4) shared-use paths, and 5) other considerations. The preferred method of providing bicycle travel depends on the type of user and the primary purpose of the travel area. In most circumstances, bicycles share the road with other vehicles, but in some circumstances no bicycle traffic on a road or a dedicated bicycle path are the preferred travel methods.

- **Shared-Use Paths**

A shared-use path is distinguished from other bicycle routes in that it is a motorized vehicle- free-route. It should be located as far from a road as practical. Intersections with shared- use paths and roads should be kept to an absolute minimum and should be designed to minimize conflicts.

- **Geometric Design Criteria for Shared-Use Paths**: One of the most important considerations in the design of shared-use path is that it is, in essence, a mini-roadway and should be designed and constructed as such. Additionally, it has been found nationally that it is virtually impossible to prevent pedestrian usage of bicycle paths. Therefore, throughout this manual the term "bicycle path" is not used. Instead, the term shared-use path is used and design standards are based on the assumption that additional path width is desirable whenever feasible.

  For shared-use paths, a horizontal and vertical alignment must be calculated for the appropriate design speed. This alignment should be staked in the field for construction, just as would be provided for a similar roadway project. Subgrade, Granular Base, and pavement courses should be provided in a similar fashion to that for a road construction project.

- **Width**: <u>If a shared use path must be in a road's right-of-way, there should be a minimum distance of 5 feet separating the shared use path from the road. If this is not possible, a suitable physical barrier is recommended. One-way traffic on the path, in the same direction as the adjacent traffic flow, is strongly encouraged. One-way paths will often be used as two-way facilities unless effective measures are taken to assure one-way operation. Without such measures, it shall be assumed that shared-use paths will be used as two-way facilities and designed accordingly.</u>
  For all shared-use paths separation from pedestrians by lane designations or adjacent sidewalk is also desirable where feasible.

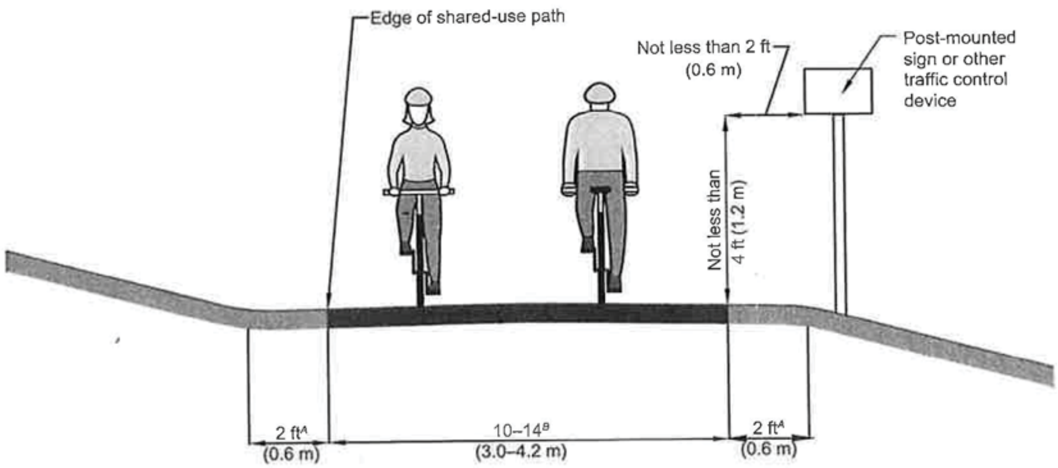
  A desirable width for shared use paths is 10 to 12 feet as these widths allow better bicycle flow and are wide enough for occasional maintenance vehicle usage. Logically, the path's width should be wider as the user volume of the path increases. In addition to the pavement width, the need to provide an adequate graded shoulder and vertical/lateral clear distances are another important consideration. A minimum of 2 feet graded grass area is the recommended area to be maintained adjacent to both sides of the pavement.

  A minimum of 8 feet for two-way traffic and 6 feet for one-way traffic is suitable if all the following conditions are met:

  - Bicycle traffic is expected to be low, even on peak days or during peak hours,
  - Pedestrian use of the facility is expected to be no more than occasional,

- There will be good horizontal and vertical alignment providing safe and frequent passing opportunities,
- Maintenance vehicles will not be used.

Figure 14.1 – Shared-Use Path on a Separated Right-of-way



Notes:
[A] (1V:6H) Maximum slope (typ.)
[B] More if necessary to meet anticipated volumes and mix of users, per the *Shared Use Path Level of Service Calculator* (9)

Reference: Adapted from the AASHTO Guide for the Development of Bicycle Facilities, 2012.

o **Clearance Distances**: A minimum vertical clear distance of 8 feet is required. A minimum vertical clear distance of 10 feet is recommended for two reasons. (1) It provides the minimum horizontal clearance that will be required by maintenance vehicles. (2) There is a “psychological shy minimum” perceived by bicyclists. With a minimum of 10 feet of clearance, bicyclists have a comfortable perception while riding under a structure. At less than 10 feet of clearance, bicyclists become uncomfortable and begin to “shy away” from the overhead structure.

An absolute minimum horizontal clear distance of 2 feet is required for all obstructions/hazards. Three feet is the recommended minimum horizontal clear for poles, trees, fences, and all other solid objects. Five feet is the recommended minimum horizontal clear distance for all embankments.

o **Design Speed**: The speed that a cyclist travels is dependent upon the geometric features of the traveled way, type of users, weather conditions, and physical condition of the rider, terrain, and path surface. In determining the design speed for a shared-use path, the geometric features of curvature, superelevation, grade, and width of the traveled way are used to produce traveling speed that is at least as high as the preferred speed of the fastest traveler. For paths less than 2% grade, a design speed of 18 mph is generally sufficient; in areas with hilly terrain and sustained steeper grades (6% or greater), the appropriate design speed should be selected based on the anticipated travel speeds of bicyclists going downhill. In all but the most extreme cases, 30 mph is the maximum design speed that should be used.

- **Horizontal Alignment:** The typical adult bicyclist is the design user for horizontal alignment. The method used to calculate the horizontal alignment is the “lean angle” method, although there are situations where the superelevation method of design is helpful. Most cyclists lean at a maximum lean angle of 20 degrees. Table 14.2 shows minimum radii for horizontal curves on paved, shared use paths at 20 degree lean angles.

Table 14.2 - Minimum Radii for Horizontal Curves on Paved, Shared Use Paths at 20% Lean Angle

Design Speed – V (mph)	Minimum Radius - R (ft)
12	27
14	36
16	47
18	60
20	74
25	115
30	166

Reference: Adapted from the AASHTO Guide for the Development of Bicycle Facilities, 2012.

- **Drainage**: It should be noted that the cross-slope of the path can be 1% on shared use paths, to better accommodate people with disabilities and to provide enough slope to convey surface drainage in most situations. A cross slope that provides a center crown with no more than 1 % slope in each direction may also be used. A minimum transition length of 5 ft. for each 1% change in cross slope should be used. Steeper cross slopes may be required on unpaved paths or other specialty trails. The Engineer should evaluate local conditions to determine which direction to slope the path.

- **Grade**: Whether or not a shared-use path is favorable to cyclists is largely dependent upon the grade and alignment of the intended path. The amount of energy a cyclist expends will affect the usage of the trail. Therefore, grades should be kept to a minimum.

  A shared-use path's grade should not be greater than 6%. Grades over 6% are considered acceptable for distances less than 400 feet long, when higher speeds are acceptable, and additional width is provided. However, due to Richmond's topography, grades up to 10% may be warranted for short distances in some locations. For all shared-use paths, grades should not exceed 3% within 50 feet of an intersection.

- **Shared-Use Path Pavement Structure**: Shared-use paths shall be machine laid using the following design standards. This standard will allow for continuous use of the path by bicycles and pedestrians as well as provide sufficient strength for occasional use by maintenance and safety vehicles.

Table 14.3 - Shared-Use Path Minimum Thickness Standards for Granular Base and Pavement Courses

	Pavement Layer:	**Thickness (Inches):**
Asphalt	Asphalt Surface	1.25 inches
	Asphalt Base	1.75 inches
	Granular Base	8 inches of DGA
	Subbase	3 inches of #2 stone (if needed)
Pervious	Pavement	6 inches of Pervious Concrete
Concrete	Granular Base	12 inches of #57 stone
	Subbase	3 inches of #2 stone (if needed)
Concrete	Pavement	6 inches of concrete
	Base	4 inches of DGA
	Subbase	3 inches of #2 stone (if needed)

- **Site Distance**: Shared-use paths shall be designed with adequate stopping sight distances, to provide bicyclists with an opportunity to see and react to the unexpected. Stopping distance for a bicycle is a function of a bicyclist's break reaction time, the initial speed of the bicycle, the coefficient of friction between the tires and the pavement, and the breaking ability of the bicycle.

Refer to the AASHTO Guide for the Development of Bicycle Facilities, 2012, Fourth Edition, or the latest edition, to calculate stopping site distance.

- **Bicycle Lanes**

  A street or roadway with a bicycle lane has a designated outside lane located within the vehicular roadway that is intended for the preferential or exclusive use of bicycles. The bicycle lane is usually 4-5 feet wide and is delineated by means of pavement markings. Bicycle lanes used on roads that allow parking should be designed to accommodate both uses. Bicycle lanes should be designed to allow cyclists to flow through intersections. Bicycle lanes shall always be one-way in the same direction as the traffic flow.

  Geometric Design for Bicycle Lanes: A Street with bicycle lanes must be designed using the following geometric design standards:

o **Drainage Grates**: Drainage inlet grates with openings large enough to entrap a narrow wheel are prohibited on streets with bicycle lanes. Suitable drainage grate designs include, but are not limited to, diagonal bars at 45-degree angles, slotted grates with cross bars, or slanted bars transverse to traffic. Long slotted grates with one (1) inch or more wide openings parallel to traffic cannot be used on streets with bicycle lanes. All such grates and covers should be kept out of the bicyclist's expected path.

o **Railroad Grade Crossings**: The road-surface should be within one-half (1/2) inch of the track height and the slot between road and track should be less than one (1) inch wide. The street should be designed so that the cyclist can cross the tracks at a perpendicular angle. Where this is not possible, commercially available compressible flange fillers must be used. Crossing guards must be utilized in the track areas. Concrete crossing guards or rubber crossing guards are preferred. Asphalt and timber crossing guards are discouraged.

o **Bicycle Lane Width**: Lane widths as defined in the Recreational Landscape Manual.

o **Signalized Intersections**: Intersections timing cycles should be adjusted to account for the bicycle lane. Loop detectors with sensitivity designed for bicycles should be installed in bicycle lanes at intersections.

- **Bicycle Route Streets**

These streets are designed to be compatible with bicycle traffic, and may not necessarily require shared lane markings for bicycles. Street routes with signs designating them “Bicycle Routes” should be constructed in a manner that meets the design requirements discussed below. The City of Richmond will designate these streets.

Geometric Design for Bicycle Route Streets: For a street to receive a designation as a bicycle route, the following geometric design modifications should be made:

- **Drainage Grates**: Drainage inlet grates with openings large enough to entrap a narrow wheel are prohibited on streets with a “bicycle route” designation. Suitable drainage grate designs include, but are not limited to, diagonal bars at 45-degree angles, slotted grates with cross bars, or slanted bars transverse to traffic. Long slotted grates with one (1) inch or more wide openings parallel to traffic cannot be used on streets with “bicycle route” designation.

- **Railroad Grade Crossings**: The road-surface should be within one-half (1/2) inch of the track height and the slot between road and track should be less than one (1) inch wide. The street should be designed so that the cyclist can cross the tracks at a perpendicular angle.

- **Outer Lane Width**: The following outer lane widths are the minimums for a street with “bicycle route” designation:

    - **Local Streets**: Can often be compatible for bicycles without additional pavement.
    - **Collector Streets**: Should provide an outer lane with a minimum width of 14 feet.
    - **Arterial Streets**: Should provide an outer lane with a minimum width of 14 feet.

- **Bicycle Signs and Pavement Markings**

In order to ensure the safe and efficient operation of shared-use paths and bicycle compatible streets, they must have adequate signs and markings to warn bicyclists of hazardous conditions or obstacles, to delineate bicycle rights-of-way, to exclude undesired vehicles from the route, and to warn motorists and pedestrians of the presence of bicycle traffic. For bicycle paths and bicycle compatible streets that meet the requirements laid out in this section, appropriate standard signs should be used to designate bicycle routes and denote appropriate warnings and hazards.

These standards are referenced in Guide for the Development of Bicycle Facilities, AASHTO 2012 and the current Manual on Uniform Traffic Control Devices (MUTCD).

Chapter 15
Design Procedures

15.1 New Road Construction Requirements

New road construction shall meet the criteria set forth within this manual and must conform to adopted City of Richmond standards and policies for design and construction.

15.2 Existing Road Improvement Requirements

Existing road improvements shall meet the criteria set forth within this manual, shall conform to the adopted City of Richmond standards and policies for design and construction, and shall conform to the initial/ultimate design plans approved when the original road was constructed.

15.3 Preparation of Plans for All Road Construction Projects

- **Design Computer Programs available**

  Various road design programs are available for the Kentucky Department of Highways Division of Information Technology and the Kentucky Division of Highway Design as well as other design programs available from commercial sources. KYCOGO, which deals with coordinate geometry, deed preparation, cross-section plots, templates, earthwork, graphics interfaces and data collector interfaces, is available through the Division of Information Technology. Software to support Computer Aided Design and Drafting is also available through that office. For information on the availability of all other computer programs relating to highway design, contact the Division of Information Technology. Information can also be accessed through the Kentucky Department of Transportation website.

- **Cover/Title Sheet**

  The cover/title sheet shall contain the following information:

  - Proper headings (City of Richmond, for example)
  - Project title
  - Construction contact information including but not limited to all utilities.
  - Sheet number
  - Checked by
  - Construction plan approval stamp box (For use by the City of Richmond)

- Index of sheets and sheets not included
- Location map
- North arrow
- Engineer’s signature and seal
- Consultant seal and signature
- Date

- **General Notes Sheet(s)**

  General note sheets shall contain a revised listing of current special notes, special provisions, general notes and other such items. Special notes unique to the project, whether plan notes or proposal notes, along with traffic notes and utility notes, shall be provided. All special proposal notes shall be prepared as follows:

  - The project number and note title shall be on the first sheet of notes or cover sheet
  - Sheet number
  - List and/or check applicable standard drawings and show total standard drawings
  - Show total bridge sheets
  - Type of work (grade, drain & surfacing)
  - Control of access
  - Design criteria
  - Project limits, begin and end stations
  - Project construction schedule
  - Location of bridges
  - Equations
  - Check breakouts, section lengths and project length
  - Scale
  - Cut and fill calculations

- **Typical Section Sheets**

  The typical section to be used on a project is generally determined by the basic geometric criteria for the functional classification of the road. The typical section sheet shows the geometric and pavement details for each project. In addition to geometric and pavement details, the typical section sheet shall show the path limits of road excavation for solid rock undercut and removal of low bearing soils which shall be utilized in the cross sections. The following information shall also be included:
  - Tangent and super elevated sections
  - Pavement design

- Undercut and sub-grade lines
- Guardrail location
- Note pertaining to slopes outside limits of shoulder
- Edge details (step-outs, keys)

- **Summary Sheets**

  Sheet for general summary, pipe drainage summary, right of way summary, paving quantities, and paving areas can be used to provide uniformity. All items shall be shown on the general summary.

  - Bid item titles, and if applicable, KDOH bid item codes are required on all summary sheets for all bid items that have been assigned code numbers in the current listing
  - Pipe quantities shall be summarized to the nearest foot length
  - Vertical elongation of culvert pipe represents an addition cost to the supplier. Therefore, reference notes shall be used to specify when vertical elongation is required, in accordance with current KDOH's Standard Drawings
  - Entrance pipe, perforated pipe and non-perforated pipe shall not be shown by location but by quantities only; however, entrance pip thirty feet or greater is classified as culvert pip and shall be shown as such by location with the quantity shown as entrance pipe.
  - Complete Material List
  - Complete Price List of all improvements and infrastructure

- **Plan Profile Sheets**

  Plan sheets may be either full size with separate profile sheets or the conventional half-plan, half-profile sheets. The first plan sheet shall contain the standard symbols. Each plan sheet shall show the beginning and ending stations for each plan sheet, a north arrow, and station equations for main line and approach intersections. Lengths of proposed structures shall be shown. The direction of centerline stationing shall run from south to north and from west to east. The alignment shall be a heavy line with the centerline stationing shown at 100-foot intervals. All P.I's, P.O.S.T.'s, P.O.T.'s and triangulation points shall be shown by stationing vertically. Each tangent shall have its calculated bearing shown and all curve data must be shown. The P.C., P.T., T.S., S.C., C.S. and S.T. must be drawn with the station number shown on a line drawn perpendicular to the point. Curve data shall be shown for all simple and spiral curves consisting of the following:

- Simple Curves
  - P.I Station Δ = Delta
  - Angle T = Tangent Distance
  - L = Length of Curve
  - R = Radius of Curve
  - E = External Distance e = Rate of Super Elevation
  - Runoff = Runoff Distance
  - Runout = Runout Distance

- Spiral Curves
  - P. I Station
  - Δ = Delta Angle
  - Ts= Tangent Distant Spiral Curve
  - Ls = Length of Spiral Curve
  - Lc= Length of Simple Curve
  - Os= Spiral Angle
  - LT = Long Tangent Spiral Curve
  - ST = Short Tangent Spiral Curve
  - R = Radius of Simple Curve
  - Es= External Distance Combination of Simple and Spiral Curve
  - E = Rate of Super Elevation
  - Runoff= Runoff Distance
  - Runout = Runout Distance

Plan sheets shall show as a minimum the following information:

- Sheet numbers
- North arrow
- Scale
- Topographic information
- Vertical controls and origin of levels
- Horizontal control
- Curve data
- Centerline and stationing
- Intersection stations
- Curb lines, gutter lines, and right of way lines, sidewalks and/or bicycle paths
- Storage of lanes and tapers
- Shoulders
- Sub-drainage
- Channelization islands
- Pavement markings

- Property lines, easements and ownership, source of title including deed book and plat
- Disturbed limits
- Drainage systems and structures
- Erosion control measures
- Approach roads
- Entrances
- Utilities (existing and proposed)

Profile sheets shall also show proposed structures with construction notes for the location, type, size and skew, surface ditches and description of all benchmarks. The first plan/profile sheet shall indicate the source of elevations used along with a summary of all USGS, USC & GS, and City of Richmond markers within the limits of the project, and the earthwork calculation for the entire project, and utility owner (with address).

- Profile sheets shall show as a minimum the following information:
- Sheet number
- Vertical curve data, grades, sight distances
- Roadway stationing
- Proposed grade elevations
- Existing profile elevations
- Surface ditching
- Drainage structures
- The plans shall extend at least 300 feet beyond the project limit

- **Scales**

Alignment and topography on plan sheets shall be plotted using a scale of 1 inch = 50 feet in rural areas and urban areas of sparse topography. Urban areas of dense topography shall be at a scale of 1 inch = 20 feet. Profile sheets shall be plotted on the same horizontal scale as the plan and the ratio of the vertical scale to the horizontal scale shall be 1:10. Ground-line and grade-line elevations shall be shown at 50-foot intervals.

Detour plan and profile shall be included and numbered with the plan and profile sheets.

- **Utility Plans**

Utility plans are required for each project if any utilities are involved. Utility plans may be either separate plans for utilities or construction plan sheets showing utilities, depending upon the complexity of the project and the number of utilities involved. The Engineer is referred to KDOH's Utilities Guidance Manual for specific procedures to be followed and for the consideration that shall be given to the effect of utility installations with regard to safety, aesthetics, operational characteristics of the highway and cost of utility construction and maintenance. The Engineer shall coordinate with the effected utility and City of Richmond Planning & Zoning Department to assure compliance with all applicable local, state, and federal permits and regulations.

- **Detail Sheets**

  Detail sheets shall consist of all other sheets not classified in the layout sheet's index of sheets and include special drawings, standard drawings not yet in the Standard Drawings, elevations development sheets, interchange and intersection layout sheets and contour grading plans.

- **Reference Sheets**

  Reference points may be plotted on the plan sheets if they are few and the plan sheets are not crowded. Otherwise, all reference points shall be plotted on a separate sheet containing only reference points.

- **Soil Profile Sheets**

  Soil profiles on 1" = 100' horizontal and 1" = 10' vertical scales shall be required for all functional classifications of roads. The soil profiles is for the use of the Engineer in establishing cut and fill slopes, CBR for pavement design, cut and embankment stability sections, rock refill, and shrinkage and swell factors.

- **Pipe Drainage Sheets**

  All inlets, manholes, pipes and culverts with the exception of entrance pipe and longitudinal pipe shall be plotted on standard cross-section sheets with slope lengths and sizes shown. Pertinent data such as discharge, high-water elevations and material quantities shall be shown.

- **Cross-section Sheets**

  Cross-sections grading plans can be used. A scale of either 1" = 10' or 1" = 5' shall be used on urban arterial, collector and local roads. Templates, end areas, grade elevations, volumes and sheet totals shall be shown. If cross-sections have been developed from aerial photography, the general notes sheet and first cross-section sheet shall carry the following note: "Cross-sections for the project developed from aerial photography."

15.4 Initial / Ultimate Design Plans

Some projects are designed with a geometric design typical section calling for two-lane initial and four-lane ultimate construction. In these cases:

- Centerline and grade shall be established to fit both initial and ultimate construction and to insure a symmetrical median and conformity to super elevation.
- Initial and ultimate construction shall be shown using solid and broken lines for all drainage, structures, special detail sheets and cross-section templates.
- Construction notes, quantities, earthwork distribution and general summary shall be for initial construction only.
- Disturbance limits shall be shown for initial construction; however, the outside limits for ultimate construction must be determined and shall be shown for right-of-way determination.
- Right-of-way acquisition and utility relocation, if necessary, shall be for ultimate construction.

- **Roadway Plan Review by the Engineer**

The primary function of this section is the final review, checking, correcting and updating of road plans to current standards and specifications immediately prior to letting of projects to contract. This requires gathering and coordinating of all the information needed for preparing bid proposals, including the plans, quantities, standard drawings, special provisions and notes. It also requires requesting and incorporating input and recommendations.

The following checklist outlines the items that are checked during the review process:

- **General Summary**

- Check all quantities, bid items, and units (use Item Code Index)
- Check to ensure Specifications, Standard Drawings, or Detail Sheets cover all bid items
- Make sure breakouts are correct and agree with those shown on the Layout Sheet for project lengths
- Include Erosion Control Item(s)
- After summary has been inked in its final form, call all quantities back to the work sheets in the project folder, and make a final check of addition, project subtotals and totals

- Make sure all applicable reference notes are shown
- Paving Areas Summary
- Compute paving areas from Plan and Profile and applicable detail sheets
- Check earthwork areas
- Check to see that all culvert pipe shown is in agreement with Pipe Sheets. Check for Flood Evaluation Data
- Check construction notes for general items such as guardrail, perforated pipe, removal items, etc.
- Be sure control of access points are shown

- **Detail Sheet**

- Check for any other special drawings that may be required (construction items not covered by Standard Drawings)

- **Soil Profile Sheets**

- Check to ensure that the Geotechnical Engineering recommendations have been incorporated into the plans
- Be sure Classification Note is shown on first sheet

- **Pipe Sheets**

- Pipe alternates
- Classes and schedules of pipe
- Pipe lengths (scaled)
- Concrete and steel reinforcement quantities for headwalls

- **Cross Section Sheets**

- When applicable, cross-section sheet shall carry the following note: “Cross-sections for this project developed from aerial photography.”

15.5 Right of Way

Sufficient right-of-way should be acquired in order to avoid the expense of purchasing developed property or the removal of other physical encroachments from the highway right-of-way. A wide section of right-of-way must be given careful consideration for a balanced design. The selection of a width based on minimum or desirable dimensions is typically established with respect to facility type and surround conditions.

15.6 Easements

Construction easements- Whenever a proposed subdivision affects an existing or proposed road in such a way that will necessitate cuts and fills in adjoining property, construction easements on such adjoining property shall be required.

15.7 Response Sheet

Attach a response sheet for all items that are not met or illustrated on the construction plans as set forth in the Construction Plan Manual.

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Chapter 16

Planning Approval/Disapproval Procedures and Design Submittal Checklist

16.1 Compliance Statement

The primary objective of all subdivision design projects is to provide maximum livability. Transportation considerations, including the physical layout and the geometric design standards, are influenced by four overall factors: (a) safety, for motorized vehicles, bicycles, and pedestrians; (b) efficiency of service; (c) livability of amenities; and (d) economy –of land use and construction/maintenance costs.

All plans submitted for review by the City of Richmond shall include a signed Compliance Statement that certifies that the plans have been prepared in accordance with this document and all other requirements of the City of Richmond. A copy of the Compliance Statement can be found in Appendix D of this document.

16.2 Traffic/Roadway Elements to be Included in Improvement Plans

In designing new roads and applying for plan approval, the Engineer shall ensure that the items in the following checklist are included in the Improvement Plans.

- **General Requirements**
    - Street names are in compliance with the City of Richmond's street-naming standard and shall not be the same (or close in spelling or phonetics) to the name of an existing street in Madison County.
    - Street numbers are to be assigned to each lot by the City of Richmond, in order to provide a separate and distinct address for each lot.

- **Existing Conditions:**
    - All contiguous land owned by the contractor to be included in the plat drawing
    - Include existing structures
    - Include building setbacks to property lines
    - Include public streets and right-of-ways on and adjacent to the property, including curbs, sidewalks, driveways, and other pedestrian/bicycle path
    - Ground elevations at appropriate contour intervals on the property and on adjacent property within 100 feet of the property
    - Easements of record, indicating location, width, and purpose
    - Utilities on and adjacent to the property
    - Wooded areas, wooded fencerows, and isolated trees greater than 1 foot in

diameter. (Showing full tree canopy size on drawing, not merely trunk location)
- Grasslands, marshes, and wetlands
- Water courses, ponds, or other water features
- Walls, rock outcroppings, mounds, and historic features

- **Grading, Drainage Plan, and Erosion Control Plan**

  - Existing and proposed contours at appropriate intervals
  - Retaining walls
  - Estimated volume of soil proposed to be moved, removed, and/or imported
  - Cut and fill plan showing depth of cuts or fills, in appropriate intervals and a cross section showing existing and proposed ground elevations

- **Street Easements, Lot Line, and Utility Easements**

  - Show all proposed public streets and alleys. For street and alley right-of-ways, show the names, bearing angles, angles of intersection, and width
  - For arc shaped streets, show the length, radii, points of curvature, and tangent bearings
  - For lot lines, show dimensions in feet and hundredths, and bearing and angles to minutes if other than right angles to the street lines
  - All easements are to be shown and clearly labeled as to their width and purpose
  - All of the following existing and proposed utility information is to be included: water mains, fire hydrants, valves storm sewers, sanitary sewers, catch basins/sediments traps, gas lines, electric lines, and cable television lines, and telephone lines. As appropriate, these liens need to show: pipe size and type, invert elevations, manhole elevations, and catch basin elevations

- **Street Profiles and Cross Sections**

  - Plan and profile of each proposed street
  - Existing and proposed ground and street grade surface on the tract and 300 feet beyond the tract
  - Centerlines and elevations at all grade change points, vertical curves and grades
  - Standard and any special cross-sections
  - Use same horizontal scale as for the approved preliminary plan
  - Use a vertical scale of 1/10 of the horizontal scale

- **Street Geometrics**
    - Conform to geometric design standards
    - Conform to cross-section design standards
    - Conform to sight triangle and minimum sight distance requirements
    - Local streets conform to a geometric design standard that discourages high-speed use by its very design and not by relying solely on signage

- **Street Continuity**
    - Streets are designed in a manner that is overall continuous in nature
    - Collector/Connector streets conform to an interconnected design standard by connect to existing Collector/Connector or arterial roads
    - Street design conforms to the “no land-locking” standard for any tract of land
    - Local streets conform to a geometric design standard that discourages high-speed use by its very design and not by relying solely on signage

- **Street Names**
    - Streets in obvious alignment with existing streets bearing same name
    - New streets do not duplicate existing street names

- **Planning For Conflicting Traffic Or Land Use**
    - Streets are designed in a manner to minimize negative impacts from neighboring and conflicting land uses

- **Half Streets and Reserve Strips**
    - Street design conforms to rules against the use of half streets and reserve strips
    - All temporary stub streets include a temporary cul-de-sac design

- **Cul-De-Sacs**
    - All Cul-de-sacs are designed to a length no longer than one thousand (1000) feet
    - All Cul-de-sacs are designed with proper bulb geometrics
    - Use of Cul-de-sacs in the design is not excessive

- **Medians**
  - Medians meet geometric design standards for the road type on which they are being used
  - Provisions for maintenance of median areas, and their associated landscaping and plantings, are provided for in subdivision plan
  - Landscaping and plantings are of a nature that they will not conflict with road sight distances

- **Pedestrian Walkways**
  - Sidewalk design requirements are met
  - Alternative pathways, including mid-block pedestrian cut throughs, bicycle/multi-use paths and bicycle lanes on road are provided—as appropriate or desired

- **Private Streets (If Applicable)**
  - All private streets in the plan meet all Richmond's special requirements for this street classification

- **Street Pavement Design**
  - Grades and embankments are appropriate to the site
  - If excavation is required, plan sufficiently meets Richmond's regulations
  - Subgrade and granular base preparation for the road are appropriate for both the site and the proposed street design and meet applicable standards
  - Base course design is appropriate for both the site and the proposed street design meets applicable standards
  - Surface course (paving) design is appropriate for both the site and the proposed street design and meet applicable standards
  - Proper street crown is incorporated into road design
  - Proper curb and gutter design are included in the roadway design

- **Intersections and Access Standards**
  - Intersections are designed to conform to Richmond's standards
  - Both access by road classification and access spacing protocols are followed

- **Landscaping**
  - Landscape planning protocols have been followed

- **Stamping Of Drawings**
    - Documents of appropriately stamped by a Kentucky licensed professional engineer
- **Response Sheet**
    - Attach a response sheet for all items that are not met or illustrated on the construction plans as set forth in the Construction Plan Manual

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Chapter 17
Roadway Construction Forms and Statements

17.1 General

All roads in the City of Richmond shall be constructed in accordance with this manual. Any item not included in this manual shall be constructed according to the Kentucky Transportation Cabinet's (KTC) Standard Specifications for Road and Bridge Construction. Items not covered by the KTC specifications shall require a special design by the Engineer and shall be approved by the City of Richmond.

17.2 Blasting

The use of explosive/blasting materials for construction purposes will require compliance with both the City of Richmond requirements, listed in the Development Ordinance, Section 510.4, Topography and Site Grading, and also the State of Kentucky regulations from the Division of Mine Reclamation and Enforcement, Explosives and Blasting Branch.

The Explosives and Blasting Branch responds to all public complaints that concern ground vibrations, noise, flyrock and other adverse effects of blasting. The investigation of these complaints involves inspection of the operation generating the complaint and extensive seismic monitoring.

17.3 Forms

Appendix D contains forms that are related to development and roadway construction activities. Some of the forms are also used for sediment and erosion control activities and used for activities other than roadway construction. They are included in this manual to ensure compliance with not only roadway construction but also for sediment and erosion control during roadway construction.

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Appendix A

Terms and Definitions

Average Daily Traffic (ADT). The average number of vehicles that pass a defined point within a 24-hour period.

Bicycle Lane. A portion of roadway designated for preferential or exclusive use by bicycles. It is distinguished from the portion of the roadway for motor vehicle traffic by a paint stripe, pavement marking, curb, or other similar device.

Shared-Use Path. A path or trail that is physically separated from the motorized vehicular traffic of a roadway. It is designed for the exclusive use of non-motorized uses, including bicycle riders, pedestrians, and other non-motorized recreational uses. This shared-use path may be either within the roadway right-of-way or within an independent right-of-way.

Bicycle Route Roadways. A road that is officially designated, signed, and marked as a bicycle route but which is open to motor vehicle travel and upon which no bicycle lane is designated.

Building Set Back Line. A line beyond which buildings must be set back from the right-of- way line.

Clearance (Horizontal). Lateral distance from edge of traveled way to a roadside object or feature.

Clearance (Vertical). The vertical distance between the roadway surface and an overhead object or feature.

Desirable. A condition that should be met when attainable. Desirable values will normally be used where the social, economic, or environmental impacts are not critical.

Developer. An individual, partnership, corporation, or other legal entity or agent thereof that undertakes the activities covered by regulations.

Driveway Approach. A driveway approach designed and intended to serve as access from a roadway to a lot or parcel of land that is adjacent to the roadway.

Easement. The right to use another person's property, but only for a limited and specifically named purpose; the owner generally continues to make use of such land since he has given up only certain, and not all, ownership rights.

Easement Area. A strip of land over, under, or through which an easement has been granted.

Encroachment. Any structure or device positioned within, over, or upon the right-of-way, that is not the property of the City of Richmond.

Engineer. A qualified Professional Engineer registered and currently licensed to practice engineering in the Commonwealth of Kentucky and competent in the area of roadway engineering.

Engineering. The preparation of plans, specifications and estimates for the contract administration of construction of streets, drainage facilities, utilities and other similar public works installed within a subdivision for public use.

Flat Terrain. Topography with grades in the range of 0% to 8%. This terrain is conducive to generally long sight distance potential with little or no construction difficulty or major expense.

Frontage. All property on one side of a street between two intersecting streets (crossing to terminating) measured along the line of the street; or if the street is dead-ended, than all of the property abutting one side between an intersecting street and the dead-end of the street.

Grade. The change in elevation between two points along the vertical alignment of a roadway. Usually expressed as the change per 100 feet or percent.

Gutter. A generally shallow waterway adjacent to a curb used, or suitable for, drainage of water.

Intersection. A point at which two (or more) streets join another street at an angle, whether or not the streets cross the other.

Movement. Is the capacity to move quantities of vehicles or people between various origins and destinations at a reasonable speed.

Owner. The governing body of City of Richmond is referred to as “owner” throughout this manual. When referenced in the context of this manual, the terms “owner” and “city” are defined to include all applicable decision making bodies in relations to roadway and/or subdivision design approvals.

Pavement (Asphalt). A flexible pavement structure consisting of mineral aggregates bound together with asphalt material. The structure maintains intimate contact with and distributes loads to the subgrade and depends on aggregate interlock, particle friction, and cohesion for stability.

Pavement (Concrete Slab). A rigid pavement structure that distributes loads to the subgrade. The pavement consists of one course of portland cement in a concrete slab. This slab has relatively high bending resistance.

Pavement. Pavement refers to the materials used to cover the ground surface along roadways. It is a combination of granular base, base course, and surface course placed on a subgrade to support the traffic load and distribute the load to the roadbed. Pavement has several distinct layers:

Subgrade. The natural soil material upon which the upper roadway layers are constructed.

Modified Subgrade. Layer designed to augment the subgrade strength. This layer is only used when subgrade strength is below a particular level. It consists of chemically altered or compacted subgrade materials, often in combination to achieve certain strength characteristics required in specific conditions. Additionally, modified subgrade acts to reduce frost and water intrusion actions.

Granular Base. Constructed on top of the subgrade. It consists of granular material such as crushed stone or gravel. The specifications for the granular base are more rigorous than that for the subgrade in terms of strength, hardness, gradation, and aggregate types. The granular base layer is placed on the subgrade to support an asphalt base course or a portland cement slab.

Base Course. The base course is the layer, or layers, of a specified material of designed thickness placed on the granular base. In the case of an asphalt pavement, the base course further serves as a foundation course to support the surface course. In the case of a portland cement pavement, there is only one course of pavement material and the base course and surface course are one and the same.

Surface Course. The purpose of the surface course is to accommodate the traffic load, provide a smooth riding surface, resist the wear and tear from traffic, provide skid resistance to vehicles, and prevent excessive water from penetrating into the base course. In the case of asphalt pavement, the surface course of the pavement section consists of a mixture of mineral aggregates and asphalt materials. In the case of a portland cement pavement, there is only one course of pavement material and the base course and surface course are one and the same.

Pedestrian Way. A travel route designed primarily for pedestrian travel.

Recommendation. The formal opinion of the city staff concerning approval, conditional approval, disapproval, or postponement of consideration of a plan or plat or the opinion of a responsible agency concerning an aspect of a plan or plat.

Right-of-way (ROW). The strip of land dedicated for public streets and/or related facilities, including utilities and other transportation uses.

Right-of-way Width. The shortest horizontal distance between the lines which delineate the right-of-way of a street.

Road. For the purpose of this manual “road” shall be defined the same as “street.”

Rocking. The preparation of a roadway base.

Rolling Terrain. Topography with grades over 8%. This terrain offers condition where the natural slopes consistently rise above and fall below the road or street grade and where occasional steep slopes offer some restriction to normal horizontal and vertical alignment.

Shall. Also defined as “must.” A mandatory condition. Where certain requirements in the design or application of this manual are described with the “shall” or the “must” stipulation, it is mandatory that the requirements be met.

Shared Parking. Parking that can be used to serve two or more individual land uses without conflict or encroachment.

Should. A desirable advisory condition. Where the word "should" is used in this manual, it is considered to be advisable and usually recommended, but not mandatory.

Sidewalk. A paved area within the street right-of-way or sidewalk easement specifically designed for pedestrians.

Sight distance. The distance visible to the driver of a passenger automobile, measured along the normal path of roadway. The minimum sight distance available on a road should be sufficiently long to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path.

Street. A street shall include a right-of-way, the street pavement, curb, and gutter. A street is primarily used as a channel for vehicular movement and secondarily as a drainage channel for stormwater. For the purposes of this manual, the terms “street” and “road” are all used interchangeably.

Street, Approved. Any vehicular way approved by the City of Richmond as providing vehicular and pedestrian travel, and--as appropriate--access to a lot. Included in this definition are:

Public Streets. All streets dedicated to the public use and which are maintained by the City of Richmond.

Private Streets. Are streets owned, constructed, used, and maintained by a particular subdivision under the appropriate Richmond subdivision regulations and the covenants of the particular subdivision.
Access Easements. When permitted, by the City of Richmond as the sole means of vehicular access to a lot, are types of restricted street that may be used by the public, or privately, as designated by the city and subject to the provisions of the Richmond subdivision regulations.

Street, Classified. A street, either existing or proposed, which is assigned a functional street Classification by the City of Richmond.

Street, Classification. Types of streets as set forth in this manual. The following street classifications are established in this manual:

> Expressways. Streets used only for movement of vehicles, providing for no vehicular or pedestrian access to adjoining properties. Expressways generally carry higher volumes, require greater right-of-way width, and permit higher speed limits than any other class of street.
>
> Arterials. Streets that should be used only for the movement of vehicles, and should not provide for vehicular access to adjacent properties.
>
> Collectors. Streets that are used both for the movement of vehicles and for providing access to adjacent properties.

Locals. Streets that are used primarily for providing access to adjacent properties.

Service Roads. Local streets that run parallel to a street with a higher classification on one side and run parallel to properties requiring access on the other side. In this way, a service road provides an access route to properties adjacent to higher classification streets while at the same time reducing the number of access points from these properties onto the higher classification streets.

Alleys. Alleys generally have two open ends, each end connects with different streets, and property generally backs onto both sides of the alley, Alleys primarily provide access to or from the rear or side of a property.

Street Grade. The officially established grade of the street upon which a lot fronts. If there is no officially established grade, the existing grade of the street at the midpoint of the lot shall be taken as the street grade.

Street Name Sign. The street name sign is the sign that designates the official name of the street.

Traveled Way. The portion of the roadway used for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

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Appendix B

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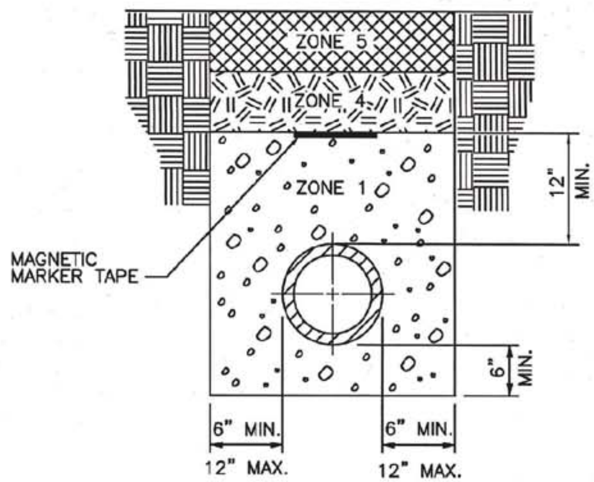
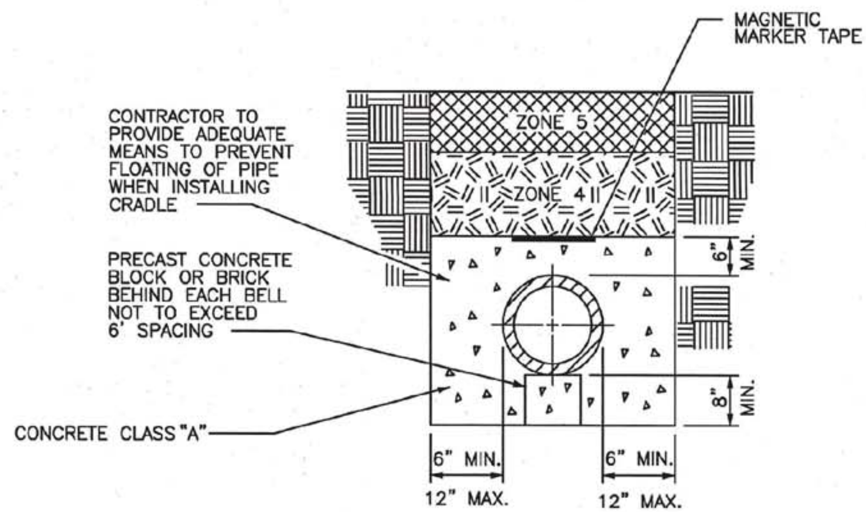
Appendix C

Standard Drawings



PIPE LAID IN ROCK
OR SOIL TRENCH



STANDARD CONCRETE ENCASEMENT
(NOTE: AS REQUIRED BY DESIGN)

PIPE BACKFILL DESCRIPTIONS	
ZONE 1	NO. 9 STONE
ZONE 2	NO. 9 OR NO. 57 STONE
ZONE 3	COMPACTED DGA
ZONE 4	CONSOLIDATED SOIL, (NO ROCK GREATER THAN 6" DIAMETER), NO. 9, OR NO. 57 STONE
ZONE 5	12" MAX. TOPSOIL, NO ROCK ALLOWED

NOTES:

1. COVER, UP TO AND INCLUDING ZONE 4 SHALL BE ESTABLISHED BEFORE TRENCH EXCAVATION.
2. ALL SANITARY SEWER LINES CONSTRUCTED FROM NON-METALLIC MATERIALS SHALL HAVE MAGNETIC MARKER TAPE INSTALLED IN THE TRENCH ABOVE THE SANITARY SEWER LINE.
3. MAGNETIC MARKER TAPE FOR SANITARY SEWER ONLY.

NO.	DATE	REVISION DESCRIPTION	BY

CITY OF RICHMOND, KENTUCKY

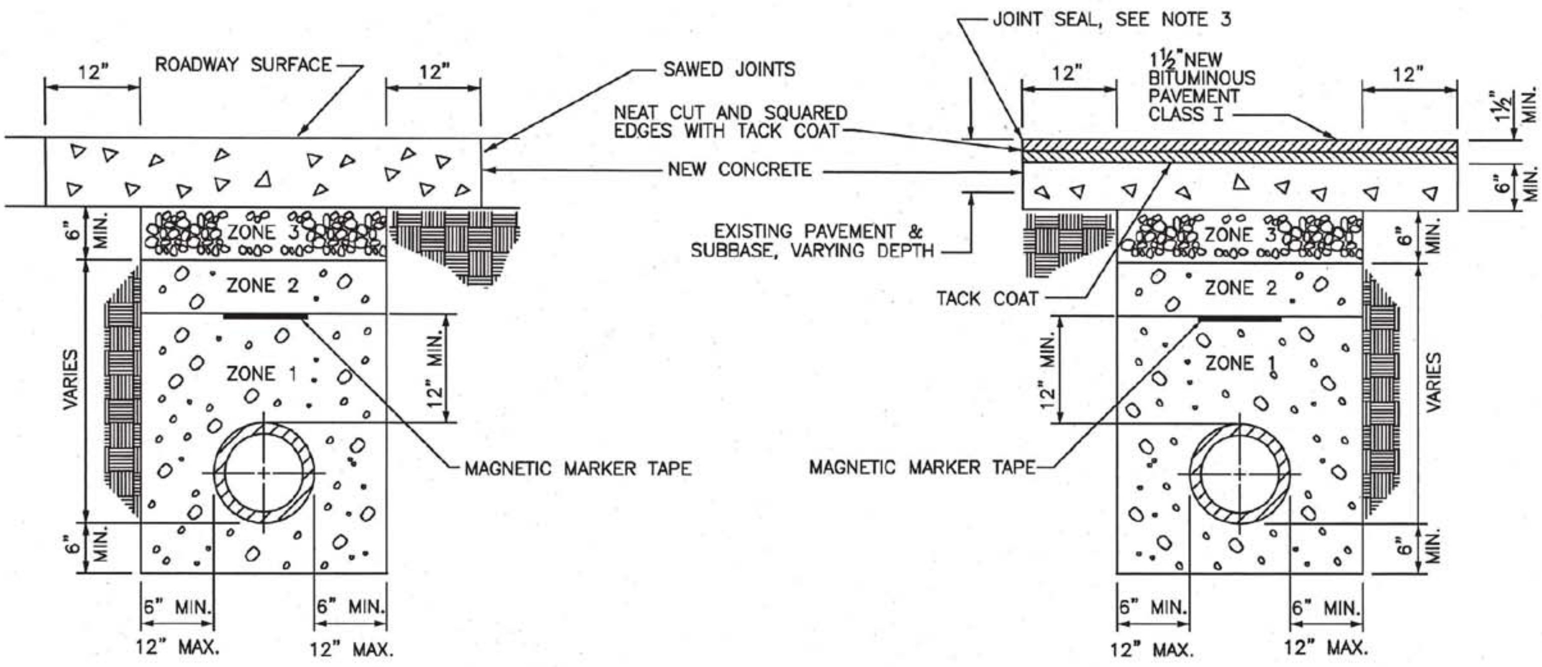
TRENCHING, LAYING, BACKFILLING AND BEDDING OUTSIDE R/W LIMITS

STANDARD DRAWING NO. 200

APPROVAL

PUBLIC WORKS DIRECTOR DATE

CITY OF RICHMOND, KENTUCKY



CONCRETE PAVEMENT

BITUMINOUS PAVEMENT

NOTES:

1. REPLACE CONCRETE PAVEMENT WITH NEW CONCRETE PAVEMENT, 6"MINIMUM OR EXISTING THICKNESS, WHICHEVER IS GREATER.
2. JOINT SEAL PERIMETER OF CUT PAVEMENT WITH FLEXMASTER POURABLE CRACK SEALANT 1109 OR APPROVED EQUAL.
3. MAGNETIC MARKER TAPE FOR SANITARY SEWER ONLY.

PIPE BACKFILL DESCRIPTIONS	
ZONE 1	NO. 9 STONE
ZONE 2	NO. 9 OR NO. 57 STONE
ZONE 3	COMPACTED DGA
ZONE 4	CONSOLIDATED SOIL, (NO ROCK GREATER THAN 6" DIAMETER), NO. 9, OR NO. 57 STONE
ZONE 5	12" MAX. TOPSOIL, NO ROCK ALLOWED

NO.	DATE	REVISION DESCRIPTION	BY

CITY OF RICHMOND, KENTUCKY

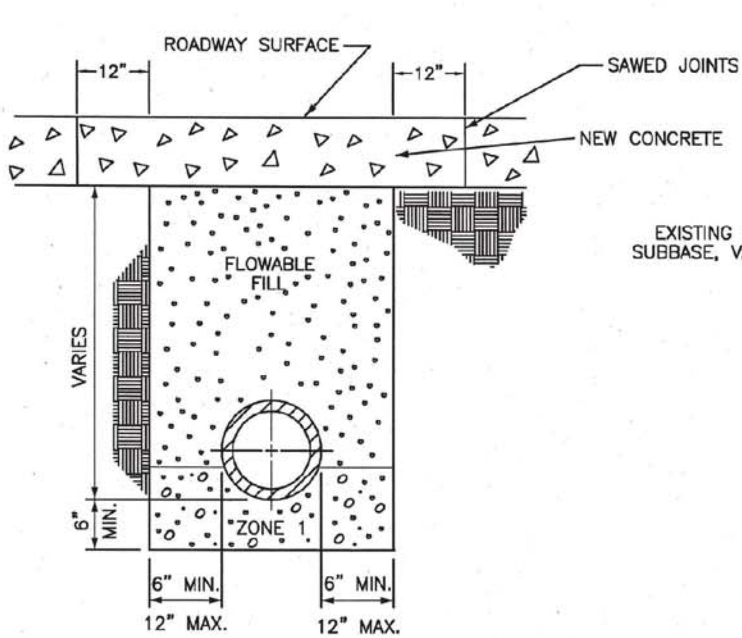
TRENCHING, LAYING, BACKFILLING AND BEDDING UNDER STREET PAVEMENT

STANDARD DRAWING NO. 201–1

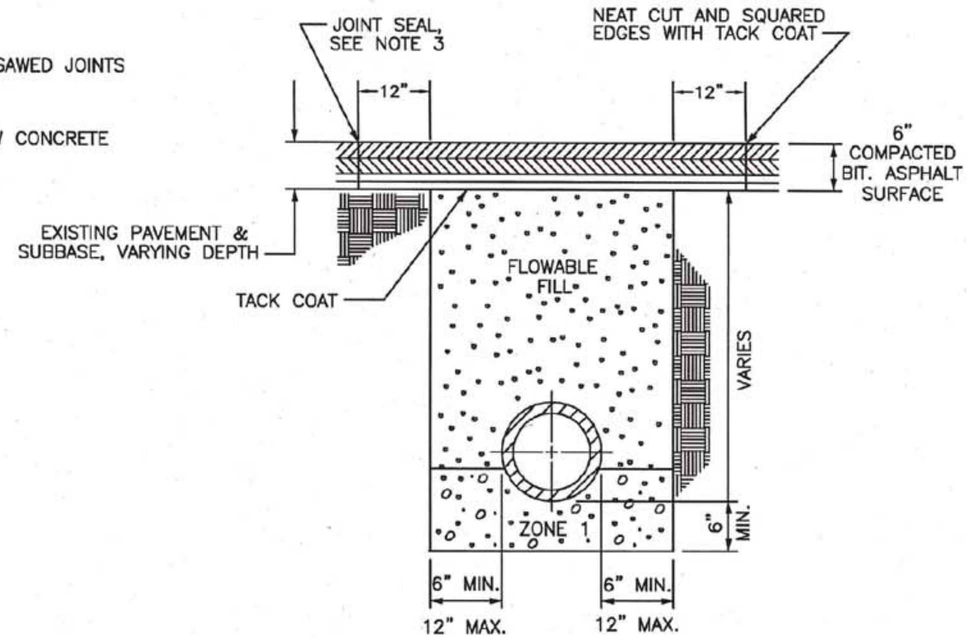
APPROVAL

PUBLIC WORKS DIRECTOR DATE

CITY OF RICHMOND, KENTUCKY



CONCRETE PAVEMENT



BITUMINOUS PAVEMENT

PIPE BACKFILL DESCRIPTIONS	
ZONE 1	**NO. 9 STONE**
ZONE 2	NO. 9 OR NO. 57 STONE
ZONE 3	COMPACTED DGA
ZONE 4	CONSOLIDATED SOIL, (NO ROCK GREATER THAN 6" DIAMETER), NO. 9, OR NO. 57 STONE
ZONE 5	12" MAX. TOPSOIL, NO ROCK ALLOWED

NOTES:

1. PER KYTC SPECIFICATION 601.03.03 FROM STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION EDITION 2004, OR MOST RECENT.
2. REPLACE CONCRETE PAVEMENT WITH NEW CONCRETE PAVEMENT, 6" MINIMUM OR EXISTING THICKNESS, WHICHEVER IS GREATER.
3. JOINT SEAL PERIMETER OF CUT PAVEMENT WITH FLEXMASTER POURABLE CRACK SEALANT 1109 OR APPROVED EQUAL.

NO.	DATE	REVISION DESCRIPTION	BY

CITY OF RICHMOND, KENTUCKY

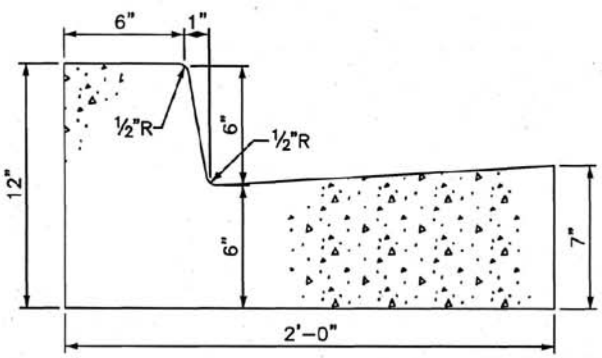
TRENCHING, LAYING, BACKFILLING, AND BEDDING UNDER STREET PAVEMENT USING FLOWABLE FILL

STANDARD DRAWING NO. 201-2

APPROVAL

PUBLIC WORKS DIRECTOR DATE

CITY OF RICHMOND, KENTUCKY



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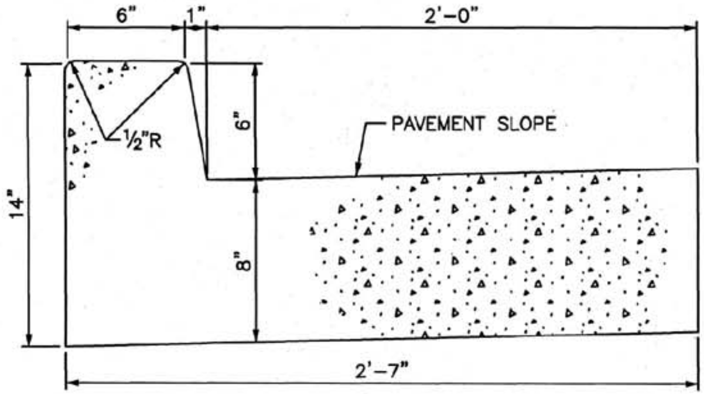

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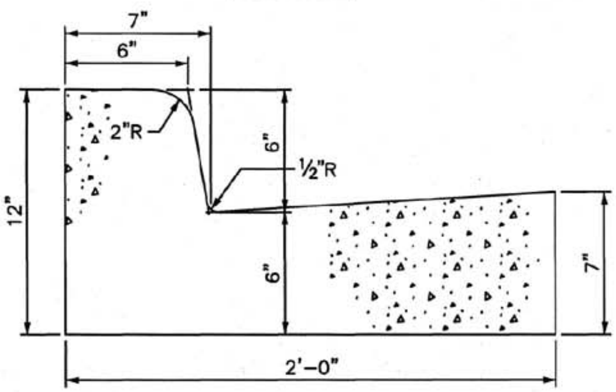
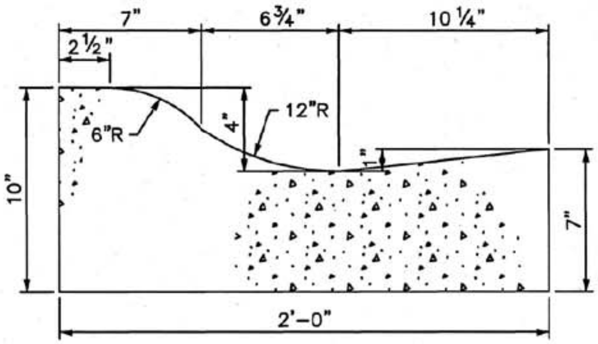


TYPE 3



TYPE 4
(RESIDENTIAL LOCAL STREETS ONLY)

NOTES:

1. CONCRETE SHALL BE KDOT CLASS "A".
2. SAWED CONTRACTION JOINTS SHALL BE CONSTRUCTED EVERY 20 FEET, WITH A MIN. DEPTH OF 3", IN ACCORDANCE WITH KDOT STANDARD SPECIFICATION.
3. EXPANSION JOINTS SHALL BE CONSTRUCTED AT ALL BREAKS IN ALIGNMENT, AT CONTACT WITH NEW OR EXISTING CONCRETE, AT ALL DRAINAGE INLETS, AT THE BEGINING AND ENDING POINTS OF CURVES, AND NOT TO EXCEED 200' MAXIMUM SPACING FOR SLIP FORM APPLICATION AND 30' MAXIMUM SPACING FOR HAND PLACED.
4. ALL CONCRETE SHALL BE CURED WITH WHITE PIGMENTED MEMBRANE FORMING COMPOUND (AASHTO M 148, TYPE 2).

NO.	DATE	REVISION DESCRIPTION	BY

CITY OF RICHMOND, KENTUCKY

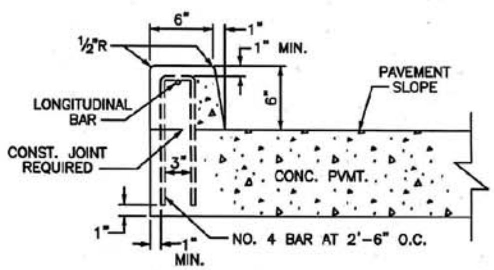
CURB AND GUTTER

STANDARD DRAWING NO. 301

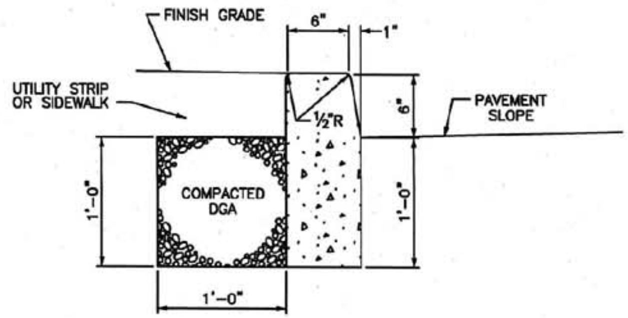
APPROVAL

PUBLIC WORKS DIRECTOR — DATE

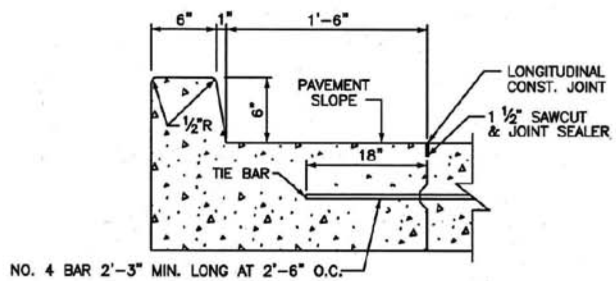
CITY OF RICHMOND, KENTUCKY



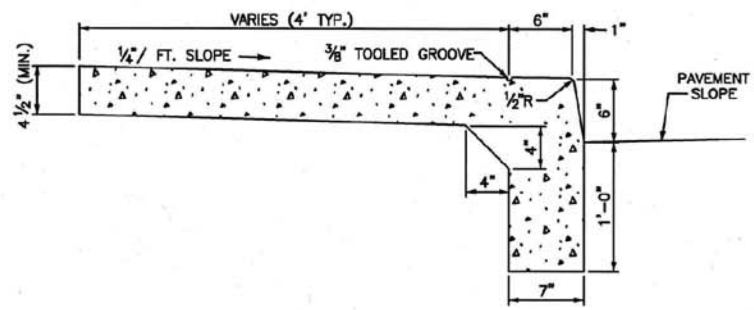
INTEGRAL CURB, TYPE 1



HEADER CURB



INTEGRAL CURB, TYPE 2



MONOLITHIC CURB AND SIDEWALK

NOTES:

1. CONCRETE SHALL BE KDOT CLASS "A".
2. SAWED CONTRACTION JOINTS SHALL BE CONSTRUCTED EVERY 20 FEET, 3" MINIMUM DEPTH.
3. THE CONTRACTOR HAS THE OPTION OF CONSTRUCTING THE STANDARD INTEGRAL CURB AS DETAILED IN EITHER TYPE 1 OR 2. IF TYPE 2 IS CHOSEN A LONGITUDINAL CONSTRUCTION JOINT SHALL BE REQUIRED AND THE REMAINING PAVEMENT AND CURB SHALL BE CONSTRUCTED MONOLITHIC WITHOUT A HORIZONTAL CONSTRUCTION JOINT AND ACCOMPANYING REINFORCING STEEL (TYPE 1).
4. EXPANSION JOINTS SHALL BE CONSTRUCTED AT ALL BREAKS IN ALIGNMENT, AT ALL DRAINAGE INLETS AND AT THE BEGINNING AND ENDING POINTS OF CURVES.
5. ALL CONCRETE, EXCEPT BONDING SURFACES, SHALL BE CURED WITH WHITE PIGMENTED MEMBRANE FORMING COMPOUND (AASHTO M 148, TYPE 2).

NO.	DATE	REVISION DESCRIPTION	BY

CITY OF RICHMOND, KENTUCKY

INTEGRAL CURB,
HEADER CURB,
MONOLITHIC CURB
AND SIDEWALK

STANDARD DRAWING NO. 302

APPROVAL

PUBLIC WORKS DIRECTOR DATE

CITY OF RICHMOND, KENTUCKY

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Appendix D

Forms

Compliance Statement (Public)
Please attach the following Certificate

<u>Compliance Certification for Public Infrastructure</u>
I hereby certify that these Construction Drawings known as:

____

have been prepared in accordance with The City of Richmond Development Ordinance; all Technical Manuals and Standard Drawings; all requirements on the certified Construction drawings; all applicable State and Federal regulations and permits; and that construction will be done in accordance of the City approved and stamped Construction Drawings.
I further certify that as a Kentucky Licensed Engineer I will provide sufficient oversight, reporting and documentation during construction to enable us to certify that the construction was done in accordance with the approved Construction Plans, State and Federal Regulations so long as we are under contract with the Owner / Developer for such services.

KY Licensed Engineer	Design Firm	Date

Owner/Developer's Signature	Date
Owner/Developer's Printed Name	Date

Compliance Statement (Private)

Please attach the following Certificate

Compliance Certification for Private Development

I hereby certify that the Development Plans known as:

____

have been prepared in accordance with The City of Richmond Development Ordinance; all Technical Manuals and Standard Drawings, all requirements on the certified Development Plan; all applicable State and Federal regulations and permits; and that construction will be done in accordance with these Development Plans. I agree to retain ____________________________ (name of design professional) to provide sufficient oversight during construction to enable him/her to certify that the construction was done in accordance with these City approved and stamped Development Plans.

I further certify that as a Kentucky Licensed Engineer I will provide sufficient oversight, reporting and documentation during construction to enable us to certify that the construction was done in accordance with the approved Development Plans, State and Federal Regulations so long as we are under contract with the Owner / Developer for such services.

_______________________________ _________________________ ____________

Design Professional Engineer Design Professional's Firm Date

____

Owner/Developer's Signature Date

____

Owner/Developer's Printed Name Date

PAVEMENT SUBGRADE INSPECTION REPORT FORM (continued)

Proof Roll:

Truck Model ______________________

Gross Weight ______________________

☐ Pass ☐ Fail

Remarks ______________________

____

____

____

CERTIFICATE OF SUBSTANTIAL COMPLETION

Date of Issuance: __________

DEVELOPER: ____

Contact: ____

Project: ____

This Certificate of Substantial Completion applies to all Work under the Contract Documents or to the following specified parts thereof:

To __City of Richmond____________

And To ____________________________________
Developer

The Work to which this Certificate applies has been inspected by the Engineer (through full-time representation as defined in the Infrastructure Development Agreement), and that Work is hereby declared to be substantially complete and in accordance with the Contract Documents.

____
DATE OF SUBSTANTIAL COMPLETION

A tentative list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include an item in it does not alter the responsibility of DEVELOPER to complete all the Work in accordance with the Contract Documents.

The responsibilities between the CITY OF RICHMOND and DEVELOPER for security, operation, safety, maintenance, heat, utilities, insurance and warranties and guarantees shall be as follows:

CITY: ____

____

DEVELOPER: ____

____

____

This certificate does not constitute an acceptance of Work not in accordance with the Contract Documents nor is it a release of DEVELOPER'S obligation to complete the Work in accordance with the Contract Documents.

Executed by ENGINEER on ______________________________
Date

____
ENGINEER

By:__________________________________
(Authorized Signature)

DEVELOPER accepts this Certificate of Substantial Completion on ____________________
Date

____
DEVELOPER

By:__________________________________
(Authorized Signature)

CITY accepts this Certificate of Substantial Completion on ____________________
Date

By:__________________________________
(Authorized Signature)

PLAT CHECKLIST

Plat Name ____

____

Final (Y/N)_______________________________________ Amended (Y/N)___________ #

____

Engineer's Stamp (Y/N) _____________________________ Land Surveyor Stamp (Y/N) _

____

Engineer's Certification and Signature____

____

Owner's Certification and Signature ___City of Richmond Certification_________________

____

Zone _____________ Length of Streets _________ Number of Lots ________________

____

Bonded (Y/N) ____________

Street Cross Sections (Y/N)______________ Cul-de-sac Detail (Y/N) _____

____

As Builts:	Sanitary:	On site	Off site
	Street:	On site	Off site
	Storm:	On site	Off site

Easements: On site__________________ Off site____________

Easement Maintenance Note (Y/N)________ Detention Maintenance Note (Y/N)__

____

Floodplain Shown (Y/N) __________ Flood Protection Elevations (Y/N) ___

____

Alluvial Soils Shown (Y/N)_________

Building Setback of 25' from the Floodplain Shown (Y/N)______________

Drainage Easements Shown (Y/N) ______________

Vegetative Buffer Strip Shown (Y/N) ____________

Monument Description Complete (Y/N) _________ Reference Meridian Identified (Y/N)

____

Unadjusted Error of Closure (Y/N) _________ Adjustment Statement (Y/N)_______

____

Bearings and Distances: On Plat:__________ Accuracy ___________ Survey Class A (Y/N)___

____

Have the requirements from the Improvement Plans been placed on the plat? (Y/N) ___________

Comments:____

____

____

____

____

____

____

City of Richmond

PRECONSTRUCTION CONFERENCE

Date: ____________ KPDES No. ____________

Project Name/No.: ____________ Project Location: ____________

Engineer: ____________
Company Name Contact Person

Owner: ____________
Company Name Contact Person

BMP Plan Preparer: ____________
Company Name Contact Person

Inspector: ____________
Company Name Contact Person

General Contractor: ____________
Company Name Contact Person

Date NOI Submitted: ____________ Copy of NOI Received? ☐ Yes ☐ No

Attach list of Preconstruction Conference attendees

On-Site Location of BMP Plan (KY10 Part IV): ____________

Process for Modifying BMP Plan (attach additional sheet if necessary): ____________

Is SPCC Plan needed? ☐ Yes ☐ No If yes, has SPCC Plan been prepared? ☐ Yes ☐ No

Is GWPP Plan needed? ☐ Yes ☐ No

Is a 404 Permit or 401 Water Quality Certification required? ☐ Yes ☐ No

If yes, has permit applications been submitted to the KDOW and the USACE? ☐ Yes ☐ No

Has permit coverage been issued? ☐ Yes ☐ No Date permit application submitted: ____________

Has the following been identified on the BMP plan: Material storage: ☐ Yes ☐ No

Waste Disposal Site? ☐ Yes ☐ No Sanitary facilities? ☐ Yes ☐ No

Concrete washout? ☐ Yes ☐ No

Are there any areas of particular environmental concern?: ☐ Yes ☐ No

If yes, please list: ____________

Other conditions:

City of Richmond

PRECONSTRUCTION CONFERENCE

Date/Time: ______________________ Project Name/No.:

Name	Company	E-mail	Phone #