ARTICLE VI
DESIGN STANDARDS FOR THE LAYOUT OF SUBDIVISIONS

SECTION 6.0 STREETS

A. Conformity to comprehensive plan and/or official map: whenever a tract of land to be subdivided or resubdivided includes any part of, or is adjacent to, a proposed arterial or collector street as designated on the comprehensive plan and/or the official map, the subdivider shall meet with the planning commission's duly authorized representative to determine its compliance (e.g., right-of-way width for future widening and pavement widths) and resulting design requirements, of such locations, otherwise such street right-of-way shall be platted by the subdivider in the exact location so designated and at the width indicated in these regulations.

B. Street Extension:

1. Existing Streets: the arrangement of streets in new subdivisions shall make provision for the proper continuation of existing streets in adjoining areas, unless determined otherwise by the planning commission, or its duly authorized representative.

2. Adjacent Property: where adjoining areas are not subdivided and are appropriate for future development, arrangement of streets in new subdivisions shall make provision for the proper projection of streets to those adjoining areas in a manner which shall provide for the practical development of the adjacent property.

3. Half Streets: dedication of one-half (1/2) of the rights-of-way (half streets) for streets proposed along the boundaries of land to be subdivided, shall be prohibited.

C. Street Classification and Function:

1. Arterial Streets: Arterial streets should be planned so as to provide for the smooth flow of traffic between points of heavy traffic generation and from one section of the community or communities to another. Such arterial streets should not traverse the entire community or communities. Arterial streets should not bisect neighborhoods but should act as boundaries between such neighborhoods. Direct access onto the roadway from abutting properties shall be discouraged.

2. Collector Streets: Collector streets should be designed to provide a traffic route from subcollector streets to arterial streets. These streets should be designed to carry traffic which has an origin or destination within the neighborhood and between arterial streets. Said streets shall be designed

in such a manner to discourage "short cuts" through the neighborhood. Direct access to abutting property should be discouraged whenever possible.

3. Subcollector Streets: Subcollector streets shall be designed to provide a traffic route from local streets to collector streets. Said streets will serve equally both traffic movement and abutting properties.

4. Local Streets, including Cul-de-sacs and courts: Local streets shall provide direct and full access to each lot and direct traffic movement to another local street or to a subcollector street. Said streets shall be laid out so that their use by through traffic will be discouraged. Local street intersections with arterial streets shall be discouraged, wherever practical.

5. Frontage Roads: Frontage roads may be required along an existing or proposed arterial street to provide access to lots along such streets.

6. Alleys: Where alleys are to be provided (e.g., in the case of certain commercial development), they shall be designed to provide only secondary access.

D. Street Rights-of-Way:

1. Widths and grades of new streets: Street right-of-way widths and grades shall conform to the following minimum requirements:

TABLE 1 - STREET RIGHTS-OF-WAY WIDTH AND GRADE REQUIREMENTS

TYPE OF STREET	MINIMUM RIGHT-OF-WAY WIDTH (IN FEET) ***	GRADES BY PERCENT (%) MAX.	MIN.
ARTERIAL	*	*	*
COLLECTOR	60	10	0.5
SUBCOLLECTOR	50	12	0.8
LOCAL (INCLUDING CUL-DE-SACS)****			
Residential	50	12	0.8
Commercial and Industrial Areas	60	10	0.8
COURTS	40	12	0.8
FRONTAGE ROAD	**	**	**
ALLEYS	20	10	0.5

* Arterial streets shall be based on current design standards and other pertinent requirements of the Kentucky Department of Transportation and the official Comprehensive Plan, but shall not contain a right-of-way width less than 30 feet.

** Requirements will vary for a frontage road depending on whether the street would serve as a Local, Subcollector or Collector type street and as such would be designed in accordance with the respective requirements of said streets.

*** Except as may be permitted in Table 3 of these regulations.

**** Descending centerline grades approaching the terminus of a cul-de-sac shall be reduced within a vertical curve to a maximum of four (4) percent unless determination is made by the planning commissions duly authorized representative that a steeper grade will provide adequate clearance for vehicles entering ascending driveways.

2. Existing Streets: Existing rights - of - way (i.e., public or private) and widths shall be determined from existing deeds or lots of record and other statutes or agencies establishing such widths. Subdivisions platted along existing streets shall dedicate additional right-of-way, if necessary, to meet the minimum street width requirements set forth in Section 6.0, Subsection D (1) of these regulations. Such dedication shall be in accordance with the following:

   a. At least the minimum right-of-way width shall be dedicated where the subdivision is on both sides of an existing street.

   b. When the subdivision is located on only one side of an existing street, one-half (1/2) of the required right-of-way width, measured from the centerline of the right-of-way, shall be dedicated. However, the owner or owners of such property shall not be required to dedicate more than one-half (1/2) of the required rights-of-way width.

E. Curves and Sight Distance Criteria:

   1. Horizontal Curve: When there is a change in the alignment of a street along the centerline, a curve with a radius adequate to insure safe sight distance shall be constructed. The minimum radii of curves shall be:

STREET TYPE	MINIMUM CURVE RADIUS
Arterial	*
Collector	400 feet
Local or Subcollector	100 feet

   2. Sight Distance: Minimum sight distance shall be as required on Tables 2A, 2B, and 2C.

3. Reverse Curves: A tangent of at least two hundred (200) feet for collector streets, shall be provided between reverse curves. No tangent shall be required for local and subcollector streets.

PROPOSED AMENDMENTS ADDENDUM 1 AS ADOPTED

TABLE 2A

SIGHT DISTANCE FOR VEHICLES EXITING FROM ACCESS POINTS ONTO ADJACENT ROADS

D= DISTANCE ALONG MAJOR ROAD FROM ACCESS POINT TO ALLOW VEHICLE TO ENTER (FEET) SEE ACCOMPANYING ILLUSTRATION IN TABLE 2C

	20 MPH				30 MPH				40 MPH				50 MPH				60 MPH			
VEHICLE TYPE	2 LANE		4 LANE		2 LANE		4 LANE		2 LANE		4 LANE		2 LANE		4 LANE		2 LANE		4 LANE	
	DL	DR	DL	DR	DL	DR	DL	DR	DL	DR	DL	DR	DL	DR	DL	DR	DL	DR	DL	DR
Passenger Car	225	195	235	205	335	290	355	310	445	385	470	415	555	480	590	515	665	575	710	620

TABLE 2B

LEFT TURN SIGHT DISTANCE FOR VEHICLES ENTERING ACCESS POINTS

S= SIGHT DISTANCE ALONG MAJOR ROUTE FOR VEHICLE TO SAFELY TURN LEFT INTO ACCESS POINT (FEET) SEE ACCOMPANYING ILLUSTRATION IN TABLE 2C

	20 MPH			30 MPH			40 MPH			50 MPH			60 MPH		
VEHICLE TYPE	2 Lane	4 Lane	6 Lane	2 Lane	4 Lane	6 Lane	2 Lane	4 Lane	6 Lane	2 Lane	4 Lane	6 Lane	2 Lane	4 Lane	6 Lane
Passenger Car	165	180	195	245	265	290	325	355	385	405	445	480	490	530	575

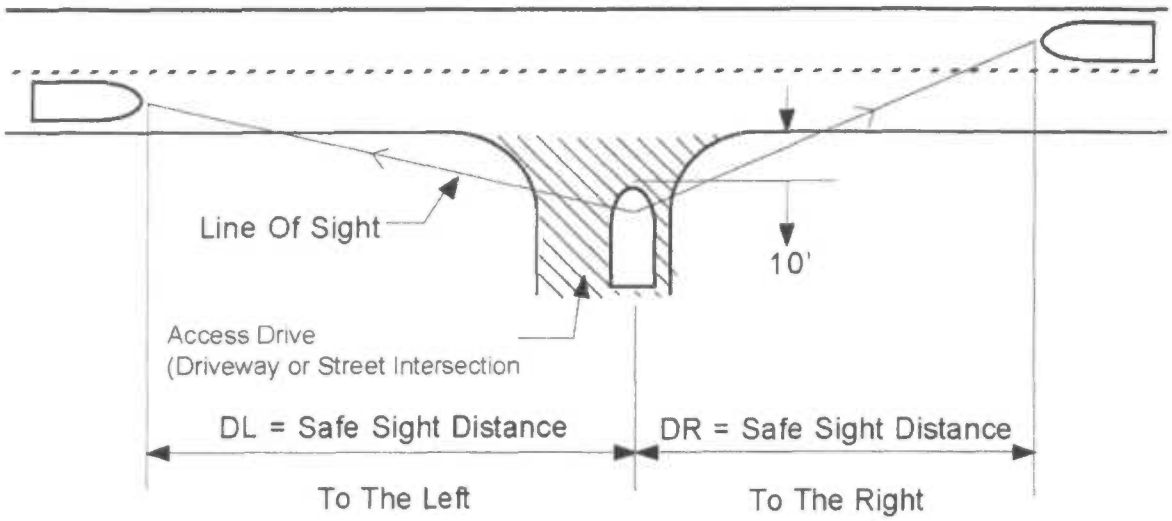
Notes: Intersection Controls shown are limited to Left and Right turns from a stop along a minor roadway; and, Left turns from a stop along a major roadway only. The Table values have been calculated and rounded for design based upon sight triangles using AASHTO - Geometric Design of Highways and Streets, Fourth Addition, 2001. AASHTO formula for Sight Distance. Left (DL) or Distance Right (DR) = 1.47 x Design or Prevailing Regulatory Speed (major road) x Time Gap. Time Gaps designated for Passenger Cars crossing lanes are as follows: 7.5 seconds - Left Turn from a Stop; and 6.5 seconds - Right Turn from Stop (Table 2A); and, 5.5 seconds - Left Turn from a Stop (Table 2B). Time Gaps are for a stopped vehicle turning left or right onto a two (2) lane roadway with no median and grades of three (3) percent or less. Table values require adjustments as follows; For left turns onto or from multiple - lane roadways with more than two (2) lanes, add 0.5 seconds for Passenger Cars for each additional lane to be crossed by the turning vehicle.

For minor roadways, if the approach grade ascends greater than three (3) percent, add 0.2 seconds for each percent grade for left turns and 0.1 seconds for right turns.

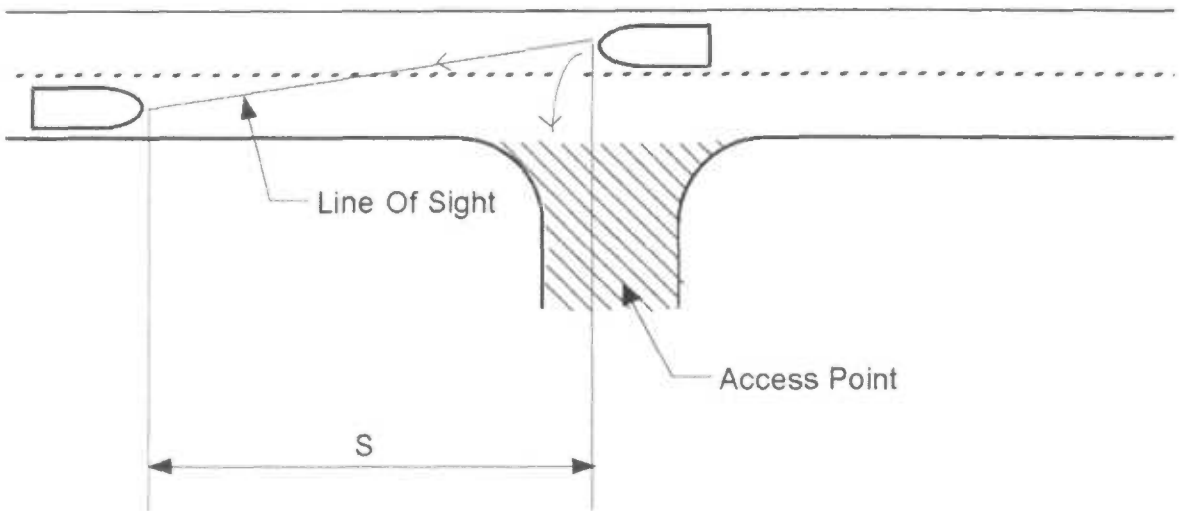
In applying the Table, calculated values are for Passenger Cars. Where substantial volumes of heavy vehicles enter these roadways, the use of other Time Gap Values for single - unit and combination trucks must be considered. These values are published in the AASHTO Design Standards.

TABLE 2C

SIGHT DISTANCE FOR VEHICLES EXITING FROM ACCESS POINTS
(refer to Table 2A)



LEFT TURN SIGHT DISTANCE FOR VEHICLES ENTERING ACCESS POINTS
(refer to Table 2B)



4. Vertical Curves: The minimum vertical curve length required shall be calculated by multiplying the algebraic difference in grades times a "K" factor. Rounded "K" factors for local and subcollector and collector streets are as follows:*

Local & subcollector	--	K=15 for crest curves
	--	K=15 for sag curves
Collector	--	K=30 for crest curves
	--	K=35 for sag curves

* Design of arterial streets shall be based on current standards of the Kentucky Department of Transportation.

F. Cul-De-Sac and Dead-End Streets: Cul-de-sacs and dead-end streets designed to be dead-end permanently, shall not be longer than 1,200 feet, unless local topographic or other physical conditions are such as to render these provisions impracticable.

G. Street Names and Addressing:

1. Duplication: The name of a new street shall not duplicate existing or platted street names within the county, or approximate such names in spelling, sound or pronunciation. The use of existing street names differentiated by alternate prefixes (i.e. "North", "South", etc.), or suffixes (i.e. "Lane", "Way", etc.) is prohibited. Street names shall not be objectionable or offensive. Street names shall be limited to no more than three (3) words including the suffix and contain no more than 20 characters including spaces. Punctuation, such as apostrophes or hyphens, etc., or numerals including fractions shall not be used as a part of any street name.

2. Continuation of Streets: New street names shall bear the same name of any continuation of, or when in alignment with, an existing or platted street, wherever practicable.

3. Street Names: All street names shall be approved and/or reserved by the planning commission's duly authorized representative, prior to approval of Improvement Drawings and Specifications.

4. Addressing: Where new streets are proposed, addressing for building development shall conform to a uniform county system and be assigned by the planning commission's duly authorized representative prior to approval of the Final Plat. Where improvements are not proposed or required, such addressing shall be assigned prior to approval of a final plat or identification plat. All addressing including numbers and street names

shall be shown for each lot or unit on Final Plats and Identification Plats for public record and distribution.

H. Alleys:

1. Alleys shall be prohibited in residential zoning districts or developments, unless otherwise approved by the planning commission, or its duly authorized representative.
2. In commercial and industrial areas, adequate alleys shall be provided where the design requires. Alleys shall not serve as part of the required off-street parking, loading and/or unloading space required by any applicable zoning ordinance.

I. Private Streets:

1. Private streets or alleys shall not be created or extended, except as approved by the planning commission, and existing ones shall, whenever practicable, be dedicated to the public. Private streets, when approved, shall be designed, constructed and inspected in accord with same minimum specific standards for public streets, per Section 7.3 and other applicable sections of these regulations.

SECTION 6.1 INTERSECTIONS:

A. Angle of Intersection: The centerline of all streets shall intersect as nearly at a ninety (90) degree angle as possible, but in no case shall the angle of intersection be less than seventy-five (75) degrees or greater than one hundred five (105) degrees, unless a special modification is granted by the planning commission due to certain exceptional conditions.

B. Centerline Offset of Adjacent Intersections: Where T-intersections are used, the following minimum centerline offsets of adjacent intersections shall be as follows:

TYPE OF STREET	MINIMUM CENTERLINE OFFSET OF ADJACENT INTERSECTIONS IN FEET
Local - Local	150
Local - Subcollector	150
Subcollector - Collector	150
Collector - Collector	200

C. Corner Radii: Property lines at street intersections shall be provided from the same radius point necessary to establish the pavement radius. If because of certain exceptional conditions, a modification is granted permitting an angle of intersection less than seventy-five (75) degrees, or greater than one hundred five

(105) degrees, then the minimum radii shall be increased or decreased, respectively.

D. Centerline Grades within Intersections: Maximum centerline grades within street intersections shall not exceed the grade for through streets, as identified in Table 1 of these regulations, depending on the type of street. The maximum grade of the centerline of the side streets intersecting with the gutter line of the through street shall not exceed four percent for a distance of not less than 75 feet from the center-line for local and subcollector streets and 150 feet for collector streets.

E. Design Adjacent to Freeways, Expressways, Arterials or Collectors: The following principles shall be used in the design of subdivisions adjacent to freeways, expressways, or arterials:

1. Street Design shall have the purpose of making adjacent lots desirable by cushioning the impact of heavy traffic and of minimizing the interference with traffic on such thoroughfares.

2. Collector, Subcollector, and Local streets shall not be permitted to intersect with freeways or expressways. The number of intersections with arterial streets shall be held to a minimum and no new intersection of any kind shall be spaced less than 600 feet from any other intersection of any kind along the same side of the arterial street. In the case of collector streets, no new intersection of any kind shall be spaced less than 200 feet from any other intersection of any kind along the same side of the collector street. At those access points where turning vehicles to and from the arterial and collector streets will affect the roadway capacity or safety, reserved turn lanes shall be required. Frontage or service roads shall be used when these spacing requirements cannot be met.

3. Where frontage roads are not required, lots adjacent to such thoroughfares shall, when practical, be served and be accessible only by a street generally paralleling said thoroughfare or by a series of cul-de-sacs or loop streets extending towards said thoroughfare from an internal street system.

SECTION 6.2 EASEMENTS:

A. Utility Easements: Public utility easements at least Fifteen (15) feet in length width may be required along the front, rear, and sides of lots where needed for the accommodation of a public utility, drainage, or sanitary structures, or any combination of the foregoing. Where deemed necessary by the planning commission's duly authorized representative, an additional easement width shall be provided.

B. Watercourses: The subdivider shall dedicate rights-of-way or provide easements for storm drainage purposes which conform substantially with the lines of any natural watercourses, channels, streams, or creeks which traverse the subdivision or for any new channel which is established to substitute for a natural watercourse, channel, stream, or creek. Such rights-of-way or easements shall be of a width which will provide for the maintenance needs of the channel as determined by the planning commission's duly authorized representative.

SECTION 6.3 PHYSICAL CONSIDERATIONS:

A. Natural Land Use: Wherever practical, subdivisions shall be planned to take advantage of the natural topography of the land, to economize in the construction of drainage facilities, to reduce the amount of danger, to minimize destruction of trees and topsoil, and to preserve such natural features as watercourses, unusual rock formations, large trees, sites for historical significance, and other assets which, if preserved, will add attractiveness and value to the subdivision and the community.

SECTION 6.4 FLOOD HAZARDS:

A. Prohibition of Development in Areas Susceptible to Flooding: Land subject to flooding or otherwise uninhabitable shall not be platted for residential, commercial, or industrial uses or for any other use which may increase the danger of health, life, property, or aggravate erosion or flood hazards. Such land within the subdivision shall be set aside on the plat for such uses as will not be endangered by periodic or occasional inundation or will not result in conditions contrary to the public welfare (e.g., use as open space, extensive recreation use, conservation purposes).

B. Areas of land adjacent to streams, rivers, or bodies of water which have a high degree of susceptibility to flooding shall be limited to development according to the following regulations, notwithstanding any other section of a zoning ordinance or any other ordinance adopted by the county.

1. The limits of the floodplain (areas subject to flooding during the occurrence of a 100 - year flood) and any floodway identified as a flood protection control areas on any official zoning or other map, pursuant to any flood insurance study prepared by the Federal Emergency Management Agency or flood study by any other agency of federal, state or local government.
2. Areas designated as susceptible to flooding during the occurrence of a 100 - year flood are further regulated by Article VII of these regulations.

   Flood data pursuant to any flood insurance study or other study may identify the elevation of the 100-year flood level and the width of the floodway. Reference to mapping and other supporting data is necessary.

In the case of proposed subdivisions located along other tributaries or bodies of water not covered in this study, stormwater drainage systems are further regulated by Article VII of these regulations.

3. No person, city, county, or other political subdivision of the state shall commence filling of any area with earth, debris, or any other material, or raise the level of any area in any manner, or place a building, barrier, or obstruction of any sort on any area including making any alteration or relocation of a waterway located within the floodway which would result in any increase in flood levels during the occurrence of a 100 - year flood discharge. In those cases where a watercourse is to be altered or relocated, the flood carrying capacity of said portion of the waterway affected must be maintained. Plans and specifications for such work shall be submitted to the planning commission's duly authorized representative for review to determine if such encroachment will meet the requirements of these regulations. Said plans shall also be submitted to the Kentucky Department of Natural Resources & Environmental Protection, Division of Water Resources, and other applicable agencies, for their review and approval, where required.

4. All land outside the floodway of the bodies of water identified in Subsection B.2., above, but located within the floodplain, may be used, provided that:

   a. Any new residential construction, including any expansion or substantial improvements of existing residential structures as herein defined, within said floodplain shall have the lowest floor elevated to or above the level of the 100 - year flood. Electrical, heating, ventilation, plumbing, and air conditioning equipment, and other service facilities shall be designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding. For all new construction and substantial improvements, fully enclosed areas below the lowest floor that are usable for parking of vehicles, building access, or storage in an area other than a basement, and which are subject to flooding, shall be designed to automatically equalize hydrostatic exit of floodwaters. Designs for meeting this requirement must be certified by a professional engineer or architect.

   b. Any new non-residential structures including any expansion or substantial improvements of non - -residential structures within said floodplain, shall have the lowest floor elevated to or above the level of the 100 - year flood or together with attendant mechanical, utility and sanitary facilities shall be designed and flood-proofed so that below the 100 - year flood level the structure is water tight with walls impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydro - dynamic loads and effects of frequency certified by a

professional engineer or architect. For all new construction and substantial improvement and elevated non - residential structures fully enclosed below the lowest floor that are usable solely for parking of vehicles, building access or storage in an area other than a basement and which are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must be certified by a professional engineer or architect.

5. All streets and utilities constructed to serve the subdivision to be located within the floodplain, but which are outside the floodway, shall be: (a) flood protected; (b) the land filled; or (c) any combination thereof, to a level of not less than the elevation of the 100-year flood level. Where the fill is partially within the floodplain, roadway access and utilities shall be provided from the "dry" side (areas located above the 100-year floodplain).

C. Stream Easement: If a stream flows through, or is adjacent to, the proposed subdivision, the plat shall provide for a storm water easement or drainage right-of-way along the stream for a floodway of at least fifteen (15) feet. For the smaller streams, the plat shall provide for channel improvement to enable them to carry all reasonable floods within banks. The floodway easement shall be wide enough to provide for future enlargement of the stream channels as adjacent areas become more highly developed and run-off rates are increased.

D. Streets: Approval shall not be given for streets within a subdivision which would be subject to flooding. All streets must be located at elevations above a flood of a 100-year frequency in order that no portion of the subdivision would become isolated by floods, except that where a secondary access is provided which would be above a 100-year flood frequency. However, streets may be permitted in areas subject to flooding of a 100-year frequency provided said streets provide access to activities relating to rivers, streams, and recreational activities located along said areas.

SECTION 6.5 BLOCKS:

A. Arrangement: The arrangement of blocks shall be such as to provide for convenient access, circulation, control and safety of street traffic. Blocks intended to be used for commercial or industrial purposes shall be designed specifically for such uses with space set aside for off-street parking and loading and/or unloading facilities as required by any applicable zoning ordinance.

B. Length: Blocks should not exceed twelve hundred (1,200) feet, except where topographical or exceptional physical conditions exist.

C. Width: The width of blocks should ordinarily be sufficient to allow for two (2) tiers of lots except for double frontage lots, as permitted in Section 6.6 of these regulations.

SECTION 6.6 LOTS:

A. Every proposed lot shall front at least 15 feet onto a publicly dedicated street. The planning commission may grant a waiver to the frontage requirement for lots proposed to be subdivided from a tract of land in the same ownership that existed on the effective date of these regulations provided the planning commission shall find:

1) That the proposed lot(s) are large, rural estate type lots; and

2) That the proposed lot(s) are consistent with the rural characteristic of the surrounding area; and

3) That access to the lot(s) is provided via a vehicular passway within a legally recorded permanent ingress and egress easement that safely and effectively circulates vehicular traffic; and

4) That the vehicular passway providing access to the lots is a minimum of 12 feet wide; and

5) That requiring the proposed lot(s) to front onto a publicly dedicated street would create an extraordinary hardship on the applicant(s).

B. Each lot proposed for residential building development in areas not served by a public sanitary sewerage system shall be a minimum of one (1) acre in size, contain a minimum lot width at the building setback line of 100 feet, and be capable of supporting an on site sewage disposal system approved by the Bracken County Health Department.

C. Lots shall not be laid out so that they have frontage onto more than one (1) street except: (a) when the lots are adjacent to the intersection of two (2) streets; or (b) when the rear of the lot faces an arterial, freeway, expressway, collector street, railroad right-of-way, etc., and the front of the lot faces onto another street.

D. All subdivisions shall result in the creation of lots which are developable and capable of being built upon. No lots may be developed which create building sites which are impracticable to improve due to known problems related to soil conditions and geological formations and areas subject to flood prone conditions based on information prepared by the U.S. Soil Conservation Service, Geological survey maps prepared by the U.S. Geological Survey, and flood prone information supplied by the U.S. Army Corps of Engineers and the U.S. Geological Survey.

SECTION 6.7 PEDESTRIAN WAYS: Where deemed necessary by the planning commission's duly authorized representative, pedestrian ways may be required, and if provided, they should not exceed a fifteen (15) percent grade, unless steps of an acceptable design, as determined by the planning commission's authorized representative, are to be constructed.

SECTION 6.8 PUBLIC SITES: Where a proposed park or other recreational area, school site, or other public ground identified in the adopted Bracken County Comprehensive Plan, is located in whole or in part within the proposed subdivision, the planning commission, or it's duly authorized representative may require a reservation, as a condition precedent to preliminary plat approval, not to exceed two (2) years, for the purchase of such public ground by the applicable public body.

ARTICLE VII
INFRASTRUCTURE IMPROVEMENTS

This article establishes standards for the design of improvements for all land uses as a part of subdivisions or other developments within the county. Improvements for primary and other infrastructure include stormwater drainage systems, sanitary sewer systems, water systems, streets, driveways and sidewalks, utilities and other related systems. All plans for improvements must be designed by a Registered Professional Engineer, reviewed, approved, constructed and inspected by the planning commission's duly authorized representative and/or other regulatory agencies, where applicable, in accord with provisions of these regulations.

SECTION 7.0 STORM WATER DRAINAGE SYSTEMS

A. GENERAL

1. This section establishes the criteria, methodology, minimum standards and specifications for design of all components of a storm drainage system. Such components may include the following systems: a) open systems (i.e. rivers, streams, creeks, channels, linings, side ditches, inlets, street curb and gutter, etc.); b) closed systems (i.e. bridges, box culverts, sewer pipe, manholes, junction boxes, etc.); c) impoundments (i.e. lakes, ponds, detention/retention basins, underground vaults, etc.); or d) combinations of open and closed systems or impoundments as an internal part of the storm drainage system.

2. Design criteria for subdivision development shall apply to all storm drainage systems within areas shown on a Preliminary Plat. Such designs must include local systems impacted by "direct runoff" from the site and extra - sized systems for "through runoff" stormwater drainage emanating from other developed or undeveloped land uses within the drainage area.

3. Any development adjacent to other facilities (i.e., floodplain, streams, highways, county roads, etc.) under the jurisdiction of federal, state and/or local governmental agencies must be "Permitted" by these agencies prior to final approval by the planning commission or its duly authorized representative for construction. In these cases, the following approvals must be obtained, where applicable.

B. EXEMPTIONS

1. The following activities are specifically exempted from these regulations:

   a. Land disturbing activities on property used for agricultural, horticultural, or botanical production of plants and animals useful to man, including but not limited to: forages and sod crops, grains and feed crops, tobacco, cotton, and peanuts; dairy animals and dairy products; poultry and poultry products; livestock, including beef cattle, sheep, swine, horses, ponies, mules, or goats, including the breeding and grazing of these animals; bees; fur animals and aquaculture, except that the construction of a structure used for agricultural proposes of one

or more acres, such as broiler houses, machine sheds, repair shops and other major buildings shall require the submittal and approval of a storm water management plan prior to the start of the land disturbing activity.

b. Land disturbing activities undertaken on forest land for the production and harvesting of timber and timber products.

c. Minor land disturbing activities such as residential gardens, individual residential or commercial landscaping, minor home repairs, or maintenance work, and construction or maintenance of individual underground utility connections.

d. Activities undertaken by local governments or special purpose or public service districts relating to the emergency repair and maintenance of existing facilities and structures. These activities will be carried out using appropriate best management practices to minimize the impact on the environment and surrounding properties.

C. DESIGN CRITERIA AND METHODS

1. DESIGN STORMS

The storm water conveyance system shall be designed to adequately handle the runoff from storms having various frequencies of occurrence from different types of development in accordance with the following general categories. To ensure the adequacy of the storm water conveyance system, the following design storms shall be used, where applicable:

a. The 10-Year Storm shall be used for all residential, commercial, institutional, and industrial uses and public facilities. Local drainage systems (i.e., inlets and closed pipe systems, etc.) for "direct runoff" shall be designed to collect and transport the post-development rate of runoff unless damaging flooding or surcharging occur when more frequent recurrence interval storms are selected;

b. The 25-Year Storm shall be used for all open channels and for sewer systems designed for a 10-Year Storm as a Check Storm to further ensure against damaging flooding or surcharging where public access emergencies or severe property losses will occur;

c. The 2, 10, 25 and 50-Year Storms shall be used to calculate pre-development runoff from a site for detention, retention, and sediment control basins;

d. The 2, 10, 25, and 50-Year Storms shall be used to determine post-development discharges for detention, retention, or sediment control basins;

e. The 100-Year Storm shall be used for all detention, retention, or sediment control basins as a Check Storm to ensure against damaging flooding or surcharging where public access emergencies or severe property losses will occur;

f. The 100-Year Storm shall be used in the design of flood control facilities;

g. The 100-Year Storm shall be used in comparison with established flood elevations from property owners, observations, KDOT drainage folder data, FEMA maps and other viable records to minimize the impacts of flooding and storm water;

h. Localized restrictions may be placed on some areas where pre-existing downstream problems or hydrologic and hydraulic models developed for the area exist. Conditions for design in such cases shall be as required by the Planning Commission's duly authorized representative.

Table 1: Summary of Design Strom Requirements

Storm Frequency	Local Drainage	Storm Water Management Control Facilities	Flood Control
2		Design (Pre & Post Development	
10	Design Storm	Design (Pre & Post Development	
25	Design Storm / Check Storm	Design (Pre & Post Development	
50		Design (Pre & Post Development	
100		Check Storm	Design Storm

2. RUNOFF COMPUTATION METHODS

a. Numerous methods of rainfall-runoff computation are available on which the design of storm drainage and flood control systems may be based. The Rational Method and the Soil Conservation Service hydrologic methods (available in TR-20, TR-55, and HEC-1) are accepted as adequate for determining peak runoff rates for drainage areas totaling 100 acres or less.

b. For larger drainage systems, the Soil Conservation Service hydrologic methods or the "Regional Method" of the Kentucky Transportation Cabinet, Bureau of Highways shall be used to determine peak runoff rates. The method of analysis must remain consistent when drainage areas are combined. The method which applies to the largest combined drainage area should be used. The engineer can use other methods but must have their use approved by the Planning commission's duly authorized representative.

c. The Modified Rational Method (MRM) may be used for design of storm water control facilities with a contributing drainage area to a storm water control facility of ten (10) acres or less.

3. RATIONAL METHOD

a. The Rational Method may only be used to calculate peak discharge rates for drainage areas of 100 acres or less. The Rational Method shall not be used to calculate the volume of storm water runoff or develop runoff hydrographs.

$$\mathbf{Q = CiA}$$

where:

Q = peak runoff quantity in cubic feet per second;

C = runoff coefficient varying with the amount of imperviousness and other characteristics of the drainage area. Table 2 presents ranges for "C" values based on specific land use types;

i = average intensity of precipitation in inches per hour, varying with frequency of storm occurrence, duration or concentration time, and area of the tributary watershed; and

A = area in acres of the tributary watershed.

b. The proportion of the total rainfall that will reach the drainage system depends on the imperviousness of the surface and the slope and ponding characteristics of the area. Impervious surfaces, such as asphalt pavements and roofs of buildings, will be subject to approximately 100 percent runoff (regardless of the slope). On-site inspections and aerial photographs may prove valuable in estimating the nature of the surfaces within the drainage area.

c. The runoff coefficient "C" in the Rational Formula is also dependent on the character of the soil. The type and condition of the soil determines its ability to absorb precipitation. The rate at which a soil absorbs precipitation generally decreases as the rainfall continues for an extended period of time. The soil infiltration rate is influenced by the presence of soil moisture (antecedent precipitation), the rainfall intensity, the proximity of the ground water table, the degree of soil compaction, the porosity of the subsoil, and ground slopes.

d. It should be noted that the runoff coefficient "C" is the variable of the Rational Method that is least susceptible to precise determination. A reasonable coefficient must be chosen to represent the integrated effects of infiltration, detention storage, evaporation, retention, flow routing

and interception, all of which affect the time distribution and peak rate of runoff.

e. Rainfall intensity (i) is the average rainfall rate in inches per hour, and is selected on the basis of design rainfall duration and design frequency of occurrence. The design duration is equal to the time of concentration for the drainage area under consideration. The design frequency of occurrence is a statistical variable that is established by design standards or chosen by the engineer as a design parameter.

f. The rainfall intensity used in the rational method is read from the intensity-duration-frequency curves based on the selected design frequency and design duration. The values of precipitation intensity in inches per hour, for Cincinnati, can be extrapolated from Exhibit No. 2-504.5 Kentucky Bureau of Highways "Rainfall Intensity-Duration-Frequency Curves" or other sources acceptable to the Planning commission's duly authorized representative.

4. TIME OF CONCENTRATION

The time of concentration is the time associated with the travel of runoff from an outer point that best represents the shape of the contributing areas. Runoff from a drainage area usually reaches a peak at the time when the entire area is contributing, in which case the time of concentration is the time for a drop of water to flow from the most remote point in the watershed to the point of interest. Runoff may reach a peak prior to the time the entire drainage area is contributing. Sound engineering judgment should be used to determine the time of concentration. The time of concentration to any point in a storm drainage system is a combination of the sheet flow (overland), the shallow concentrated flow and the channel flow, which includes storm sewers. The minimum time of concentration for any area shall be 6 minutes.

5. TIME OF CONCENTRATION CALCULATIONS

The Soil Conservation Service TR-55 method for calculating the time of concentration shall be used.

Table 2 - Rational Method Runoff Coefficients for Composite Analysis		
Land Use Description	**Average Percent Imperviousness**	**Runoff Coefficient (C)**
Natural and Undisturbed Areas	Varies	0.4
Single Family Residential Average Lot Size/Width	Varies (See Below for Value)	0.43-0.76 (See Below for Value)
3 acres/300 feet	6	0.43
2 acres/200 feet	7	0.44
1 acre/100 feet	12	0.47
1/2 acre/100 feet	23	0.53
12,500 sq. ft./80 feet	34	0.59
9,000 sq. ft./70 feet	42	0.63
8,500 sq. ft./60 feet	44	0.64
6,000 sq. ft./50 feet	48	0.66
<6,000 sq. ft./<50 feet	65	0.76
Industrial	72	0.80
Multi-Family Residential	75	0.81
Commercial/Office	85	0.87
Impervious Areas Including; Pavement, Roofs, Drives, Sidewalks, etc.	100	0.95

6. RUNOFF COEFFICIENTS

Runoff coefficients (C) for the land uses shown in Table 2 must be used unless actual impervious areas are calculated and composite (C) factors are determined and submitted. When Composite (C) factors are used, impervious areas with a C = 0.95 and all other areas with a C = 0.40 shall be used. In no case shall post-development runoff coefficients be less than pre-development runoff coefficients.

7. SOIL CONSERVATION SERVICE METHOD

The Soil Conservation Service (SCS) Method may be used to calculate the peak discharge rates; develop runoff hydrographs for basins and subbasins; determine runoff volumes; and provide inflow information to determine the required storage volume for detention and retention basins. The SCS Method is the preferred method for performing hydrologic analysis. The SCS Method will utilize the formulas, constants and data I the current manual from the U.S. Natural Resources Conservation Service. The Soil Conservation Service utilizes a 24-hour storm duration, which is considered to be acceptable for Northern Kentucky. When the Soil Conservation Service methods are used, the Type II rainfall distribution shall be used. For detailed information, the user is referred to the following Soil Conservation Service publications:

a. NEH-4: "Hydrology," Section 4, National Engineering Handbook;

b. TR-20: Computer Program for Project Formulation, Hydrology;

c. TR-55: Urban Hydrology for Small Watersheds;

d. TP-149: A Method for Estimating Volume and Rate of Runoff in Small Watersheds.

8. KENTUCKY TRANSPORTATION CABINET REGIONAL METHOD
The Regional Method of the Kentucky Transportation Cabinet, Bureau of Highways (Regional Method) may be used to calculate the peak discharge rates when required by regulatory agencies such as the Kentucky Division of Water. The Regional Method will utilize the formulas, constants and data from the current Manual of Instruction of Drainage and Design, Kentucky Transportation Cabinet, Bureau of Highways.

9. MODIFIED RATIONAL METHOD
The Modified Rational Method (MRM) may be used for design of storm water control facilities. The maximum contributing drainage area to a storm water control facility designed with the MRM is ten (10) acres. If the Modified Rational Method is used by computer program, the storm duration used shall be the one that produces the maximum storage. If calculating by hand, the duration shall be greater than the time of concentration.

D. DESIGN OF STORM SEWERS

1. PURPOSE OF STORM SEWERS
Storm sewer systems are designed to collect and convey storm water runoff from street inlets, runoff control structures, and other locations where the accumulation of storm water is undesirable. The objective is to remove runoff from an area fast enough to avoid unacceptable amounts of ponding damage and inconvenience.

2. PEAK DISCHARGE CALCULATIONS
The method of runoff calculation for determining peak discharge (Q) for a drainage area shall be the methods described in Section 302.

3. SEWER FLOW TIMES
Flow times in sewers or conduits to the point of design may be determined from the hydraulic properties of the sewers upstream of that point, assuming average flow-full velocity at the proposed sewer slopes.

4. STORM SEWER DESIGN
Public storm sewer pipes shall be designed to carry peak flows as determined by the methods previously described. For the design storm, the drainage system shall be designed as open channel (non-surcharged) flow. Sizes shall be determined by Manning's formula using a range of roughness coefficients (N=0.009 - 0.024).

5. MINIMUM PIPE SIZES

The minimum diameter for public storm sewer pipe shall be 15 inches for inlet headwalls and 12 inches for systems with a catch basin at the initial point.

6. PIPE VELOCITIES

Velocities in public storm sewer pipes, when flowing full at average peak flows, shall not be less than 2.0 feet per second. Velocities shall be non-erosive at the re-entrance into the natural stream or downstream channel. The downstream receiving channel or stream must receive adequate protection against erosion through the use of erosion prevention practices or energy dissipation devices if the storm sewer discharge would cause erosion. The outlet velocities of all headwalls shall be included in the drainage calculations.

7. PIPE GRADES

Storm sewer pipe shall be laid on gradients so that the velocity (flowing full) shall be kept within the foregoing stated minimum and maximum, unless other special provisions are made. Sewers on 20 percent slopes or greater shall be anchored securely with concrete anchors or equal, spaced as follows:

a. Not over 36 feet center to center on grades 20 percent and up to 35 percent;

b. Not over 24 feet center to center on grades 35 percent and up to 50 percent; and

c. Not over 16 feet center to center on grades 50 percent and over.

8. HYDRAULIC GRADE LINES

To ensure against surface ponding or street flooding, due to surcharging, the hydraulic grade line (HGL) in any inlet or manhole may not be higher than the inlet grade. The HGL for the 10-Year Design Storm and 25-Year Check Storm shall be shown on all profiles of the storm water system.

9. REDUCTION OF PIPE SIZE

Design of all public storm sewer appurtenances shall consider the balance of energy plus the loss due to entrance in all structures having a critical change in horizontal or vertical alignment. In no case shall the difference in invert elevations be less than the result of equal crowns when a smaller pipe empties into a larger one. In no case shall storm sewer pipe sizes be reduced more than one standard increment of pipe diameter due to an increase in invert gradient after balancing the energy losses within the structure.

10. MANHOLES

Manholes shall be constructed in accord with Standard Construction Drawings as shown in Appendix "C".

11. DROP MANHOLES

Drop manholes may be required to reduce the slope of any sewer that has a velocity that exceeds 20 feet per second. Pipes shall not extend more than 2 inches into the side of the manhole, and the invert of the outlet pipe shall be at the bottom.

12. INLETS

a. Capacity:

The capacity of on-street inlets should not be less than the quantity of flow tributary to the inlet. Inlets at low points or sags should have extra capacity as a safeguard for street flooding from flows overtopping the street curb. Curb openings or combination inlets should be used for overflows in the event that the grate is clogged. Special inlets may be required for streets with steep gradients to provide the extra capacity such situations require. Where avoidable, inlets should not be placed along streets where driveways and/or aprons conflict with mountable roll or depressed curbing. The 10-Year Design Storm return period shall be used to design storm water inlets. Curb inlets and gutters shall approximate a storm intensity of four (4) inches per hour. Design methodology utilized should be similar to those presented in manuals produced by the Kentucky Transportation Cabinet or other manuals approved by the Planning commission's duly authorized representative.

b. Type:

(1) On - street combination type inlets (single or double) shall be used and installed in accord with "Standard Construction Drawings" as shown in Appendix "C", or approved equal.

(2) Off - street type inlets shall be used and installed in accord with "Standard Construction Drawings" as shown in Appendix "C", or approved equal. Where pipe openings are 24 - inches and less, types of inlets used shall be those defined as yard drain, sloped and flared box inlets and/or sloped box inlets type 1 or approved equal. Standard and/or wing walled type headwalls serving pipes 24 - inches and smaller are prohibited for use as inlets unless provided with enclosure grates in accord with these regulations. Except for inlets serving temporary silt basins, detention and/or retention basins or pipes or other openings greater than 24 - inches, the maximum dimension of opening on all storm water inlets shall be limited such that a sphere with a diameter of 6-inches cannot pass through any opening.

c. Location:

(1) Inlet spacing along streets shall be based upon gutter and inlet capacity, street slope, and contributing drainage area. The spacing of inlets should ensure that street drainage generated along continuous grades or in sags will not flood and damage private properties or

residential basements. In general, the spacing of combination inlets shall not exceed the following requirements, unless detailed hydraulic computations indicate otherwise and are submitted with Improvement Drawings and Specifications:

(a) Along continuous grades (less than two percent) - 400 feet maximum;

(b) Along continuous grades (two percent and over) - 600 feet maximum;

(c) At sag locations (draining less than two percent grades) - 400 feet maximum between inlets or from a high point;

(d) At sag locations (draining two percent and over grades) - 600 feet maximum between inlets or from a high point;

(e) Inlets shall be placed immediately upstream of pedestrian walkways and designed to intercept 100% percent of the flow;

(f) Inlets placed at locations other than in (e) above shall be designed to intercept 75% of the flow; and

(g) Inlets for drains connected to the combined sewer system or/other systems having known Infiltration/Inflow problems should be designed with flow-throttling capabilities, if required.

d. Special consideration should be given to storm drainage entering cul-de-sacs. Additional inlets shall be required when drainage areas and/or street slopes are excessive. In addition to an inlet provided near the low point within the cul-de-sac, two (2) additional inlets shall be required along each curb prior to the entrance of the cul-de-sac in accord with the following criteria:

(1) For street slopes less than eight (8) percent and draining more than 400 feet of pavement; and

(2) For all street slopes more than eight (8) percent and draining more than 300 feet of pavement.

13. CAPACITY OF OFF-STREET YARD DRAINS

The capacity of the surface openings on off-street yard drains shall not be less than two (2) times the discharge 'Q' for a 10-Year Design Storm from the contributing drainage area to allow adequate discharge when debris accumulates. To improve safety at yard drains, ponding or headwater submerging such inlets shall not exceed a depth of 1.0 feet above the highest

opening of any inlet at its surface for a 10-Year Design Storm. A 25-Year Check Storm shall be used to further ensure against damaging flooding and property losses.

14. CAPACITY OF OFF-STREET INLETS

The capacity of off-street inlets with enclosure grates or other open headwalls or culverts shall not be less than two (2) times the pipe diameter above the invert where water would rise to a maximum level for a 10-Year Design Storm for improved safety. A 25-Year Check Storm shall be used to further ensure against damaging flooding and property losses.

15. STORM SEWER OUTFALLS

When a storm sewer system outfalls into a flood plain of any major watercourse, the outfall must not be subject to frequent floods or backwaters. Standard headwalls and/or headwalls with wingwalls including rock channel protection as aprons as erosion control, shall be constructed for all outfalls. Suitable baffles or other energy dissipaters shall be provided if maximum velocities are exceeded. The invert of the first storm sewer appurtenance upstream of the outfall structure shall be above the elevation of the calculated 100-year flood plain. The calculated 100- year flood plain for all channels with a drainage area of more than 50 acres within the land disturbing, development, or re-development activity shall be shown on the site plan.

16. CULVERTS AND BRIDGES

Culverts and bridges shall be designed in accordance with the methods given in the "Manual of Location and Design" published by the Kentucky Department of Highways; except that storm water quantities to be handled by the culverts and bridges shall be determined on the basis described in these standards. The allowable headwater (AHW) shall not be greater than HW/D = 2.+.

17. HEADWALLS AND SAFETY RAILINGS

a. Except for driveway entrance pipe, headwalls or other structures shall be constructed at the inlet and outlet of all storm sewers in accord with "Standard Construction Drawings" as shown in Appendix "C". Concrete headwalls per Appendices C-24 and C-25 for pipe diameters 24 - inches and less shall be used for outlets only. Same sized headwalls are prohibited for use as inlets.

b. Safety railings shall be provided along the top and sloped/winged side walls on all headwall inlet and outlet structures or other culverts or bridge structures having a vertical drop of 4' – 0" or greater. Such guards or railings shall be at least 42 – inches in height measured vertically above the walls. Openings in guards shall have balusters or ornamental patterns that do not provide or create a ladder effect such that a sphere with a diameter of four (4) – inches cannot pass through any opening, except for the top eight (8) – inches. Safety railings and attachments shall be made of materials that are weather resistant and ultraviolet (UV) light resistant adequate in strength to resist uniform,

concentrated and impact loads in accord with the applicable sections of the Kentucky Building Code, latest version. Safety railings constructed of wood are prohibited. In addition, the use of landscaping buffers does not qualify as an acceptable safety railing.

18. SPECIFICATIONS FOR CONSTRUCTION MATERIALS

In all other respects, the design, materials, and construction shall be as specified in Sections 601, 602, 610, 611, 612, 616, 704, 706, 709, 710, 737, "State of Kentucky Standard Specifications for Road and Bridge Construction", and in accord with "Standard Construction Drawings", shown in Appendix "C". Non-circular pipe may also be specified.

The following types of pipe shall be specified as a minimum for storm sewers, in accord with the following requirements:

a. Reinforced Concrete Pipe (RCP AASHTO M 170, ASTM C76 and AASHTO M198)
   (1) 27" - 120" Class II Wall A, B or C Max. Cover 11 feet;
   (2) 18" - 120" Class III Wall A, B or C Max. Cover 22 feet
   (3) 12" - 120" Class IV Wall A, B or C Max. Cover 36 feet.

   Notes: (1) Minimum Class III shall be required beneath all street pavements or driveways.
   (2) Design and installation shall be in accord with AASHTO Section 17 Soil-Reinforced Concrete Structure Interaction Systems, ASTM C12 or ACPA Design Data 40, where applicable, except that Pipe Bedding and Trench Conditions shall be per Appendix C.

b. Bituminous Coated Galvanized Corrugated (2-2/3" x 1/2") Steel Pipe (AASHTO M36 Type I, AASHTO M218 and AASHTO M190 Type A):
   (1) 12" - 36" 16 Gauge
   (2) 42" - 54" 14 Gauge
   (3) 60" 12 Gauge
   (4) 66" - 72" 10 Gauge

c. Bituminous Coated Galvanized Corrugated (3" x 1") Steel Pipe (AASHTO M36 Type 1, AASHTO M218, and AASHTO M190 Type A)
   (1) 36" - 90" 16 Gauge
   (2) 96" - 102" 14 Gauge
   (3) 108" - 120" 12 Gauge

d. Bituminous Coated Galvanized Spiral Rib (3/4" x 3/4" x 7-1/2") Pipe (AASHTO M36 Type I, AASHTO M218, and AASHTO M190 Type A):
   (1) 18" - 36" 16 Gauge
   (2) 42" - 54" 14 Gauge

(3) 60" - 72" 12 Gauge

Note: Bituminous Coating within items b. thru d. shall be quality controlled by the manufacturer. Field coating of any pipe shall be prohibited. Bituminous coating not required for driveway entrance pipe.

e. Aluminized Type 2 Corrugated (2-2/3" x 1/2") Pipe (AASHTO M36 Type 1, AASHTO M274)
   (1) 12" - 36" 16 Gauge
   (2) 42" - 54" 14 Gauge
   (3) 60" - 12 Gauge
   (4) 66" - 72" 10 Gauge

f. Aluminized Type 2 Spiral Rib (3/4" x 3/4" x 7-1/2") Pipe (AASHTO M36 Type 1, AASHTO M274)
   (1) 18" - 36" 16 Gauge
   (2) 42" - 54" 14 Gauge
   (3) 60" - 72" 12 Gauge

g. Aluminum Spiral Rib (3/4" x 3/4" x 7-1/2") Pipe (AASHTO M196 and M197)
   (1) 18" - 30" Gauge 14 Max. Cover 30 feet
   (2) 36" - 48" Gauge 12 Max. Cover 30 feet
   (3) 54" - 66" Gauge 10 Max. Cover 30 feet.

Notes: (1) All joints for corrugated and spiral rib pipe for items b. thru g. shall be special joints having bolt, bar and strap premium '0' Ring Gasket connectors; (2) Design, installation and maximum height of cover (except as stated for item g.) shall be in accord with AASHTO Section 26 Metal Culverts except that Pipe Bedding and Trench Conditions shall be per Appendix C.

h. Polyvinyl Chloride (PVC) Pipe
   (1) Smooth Wall:
   (a) Pipe/Fittings: ASTM D 3034; ASTM F679; AASHTO M 278
   Material: ASTM D 1784
   Joint: ASTM D 3212
   Sizes: 12" - 27" or other size available
   Minimum Pipe Stiffness: 46 @ 5% deflection
   Installation: ASTM D 2321.

   (2) Ribbed:
   (a) Pipe/Fittings: ASTM F794; ASTM F949; AASHTO M304
   Material: ASTM D 1784
   Joint: ASTM D3212
   Sizes: 12" - 48" or other size available
   Minimum Pipe Stiffness: 46 @ 5% deflection

Installation: ASTM D 2321

(b) Pipe/Fittings: AASHTO M 304
Material: ASTM D 1784
Joint: ASTM D 3212
Sizes: 18" - 48" or other size available
Minimum Pipe Stiffness: Variable @ 5% deflection
Installation: ASTM D 2321.

i. Polyethylene (HDPE) Pipe

(1) Corrugated:
(a) Pipe/Fittings: AASHTO M294 Type S
Material: ASTM D 3350
Joint: Minimum silt tight including: (a) thermally molded; (b) integral bell; or (c) bell and spigot with built-in gasket coupler assemblies only.
Sizes: 12" - 30" only
Minimum Pipe Stiffness: Variable @ 5% deflection
Installation: ASTM D 2321.

NOTES: (1) Design, installation and maximum height of cover for items h. and i. shall be in accord with AASHTO Section 18 - "Soil - Thermoplastic Pipe Interaction Systems" except that Pipe Bedding and Trench Conditions shall be per Appendix C;

(2) Design engineer shall be required to submit a special design or additional documentation for any variation to minimum standards as stated above.

(3) Minimum height of cover for all pipe shall be 12-inches (measured from bottom of rigid or flexible pavement) except for aluminum conduits with diameters greater than 48 inches require 24 inches; (4) All pipe installations greater than 30-inches require full-time on-site inspections under the direction of a qualified Geotechnical Engineer or Firm.

E. DESIGN CRITERIA FOR STORM WATER DRAINAGE CHANNELS AND WATER COURSES

1. PURPOSE OF STORM SEWERS

Open channels provide many advantages in the management and control of storm water runoff. Such channels provide for natural infiltration of storm water into ground water supply and extend the Time of Concentration (Tc) helping to maintain the runoff rate nearer to that which existed prior to development. The objective of open channel flow design is: (a) to determine a channel slope and size that will have sufficient capacity to prevent undue flooding damage during the anticipated peak runoff period; and (b) to determine the degree of protection based on stream velocity to prevent erosion

in the drainage channel. Existing drainage channels, which will remain undisturbed, shall not be required to be reconstructed unless additional capacity and erosion control is required.

2. DESIGN STORMS

Storm water drainage channels and watercourses shall be adequate to handle runoff from storms of the frequencies of occurrence and duration shown for the degrees of site development as follows:

a. For all developments - 25-Year Storm.

b. For main flood control channels - 100-Year Storm frequency.

c. The runoff computed from these storms shall be that from the area within the development or re-development.

3. PEAK FLOW CAPACITY

Each portion of the storm water system of drainage channels and water courses shall be capable of handling the peak flows as determined by the proper method previously described in Section C.

4. DRAINAGE CHANNEL CAPACITIES

Drainage channels shall be designed to carry peak flows as determined by the methods previously described. Channel cross-section areas shall be determined by Manning's formula, using a value of n = 0.030 for earth sections, n = 0.020-0.025 for aggregate linings, and n = 0.015 for paved sections.

5. CHANNEL LININGS

When open drainage channels require various lining types to attain ultimate design capacity, the earth sections of the drainage channel and its structure shall be designed and constructed to the ultimate design required. Lining will not be required in the initial construction and may be delayed until development of the area produces runoff quantities large enough to result in erosive channel flows, unless drainage channel velocities are excessive initially.

6. CHANNEL DESIGN VELOCITIES

Runoff flows in open channels may cause accelerated erosion. Such erosion can be controlled by limiting velocities, changing the channel lining, and reshaping the channel to spread the flow of runoff. Methods of controlling erosion in open channels include the following: (1) grass covers or sod; (2) Type II channel lining; and (3) reinforced concrete or pre-cast paving. Erosion control for drainage channels shall be provided as follows:

a. Design velocities should generally be greater than 1.5 feet per second to avoid excessive deposition of sediments. When flat slopes are unavoidable, concrete paving should be used to accelerate runoff.

b. When design velocities are between one (1) and one-half (1.5) and four (4) feet per second, the bottom and sides of the earth channel shall be

seeded, mulched and fertilized to an elevation of three (3) feet above the design water surface. Seeding shall be a perennial or annual mixture of grass seeds at a rate of 75 pounds per acre. Acceptable whole fertilizer shall be applied at a rate of 75 pounds per one thousand feet. On slopes over five (5) percent, the bottom and sides of the earth channel shall be sodded and pegged to remain in place. Where seeding or sodding is required and the soil is not capable of supporting vegetation (such as sandy soil or other clay types), appropriate action shall be taken to bring the soil to an acceptable condition which will support the growth of seed or sod.

c. When velocities exceed four (4) feet per second, the bottom and sides of the earth channel shall be protected from erosion with an application of stone rip-rap, coarse aggregate and/or dumped rock channel linings. The type of application thickness and quantities shall be designed by the engineer to ensure maintenance-free permanent stabilization. Reinforced concrete pavement at least four (4) inches thick may also be used at bends, changes in alignment, junctions with other ditches, and at other locations where erosion is likely to occur. On slopes over ten (10) percent, consideration should be given to the construction of larger sized channel linings, gabions (wire boxes) or paved channels with energy blocks or dissipators to reduce excessive velocities and damage to receiving streams.

d. Consideration shall be given for the construction of other methods of lining for erosion control including check dams, drop structures, gabions, etc. subject to approval of the Planning commission's duly authorized representative.

7. LOT GRADING AND DRAINAGE

a. Lot grading shall be accomplished as follows: Except for driveways in transition (higher or lower than the street - See Appendix "C") within the limits of the public right-of-way adjacent to street pavements, all final grading for grass strip, driveway and sidewalk, shall comply with minimum and maximum grades in accord with typical sections for streets as shown in Appendix "C". For lots that drain toward streets which include curb and gutter sections, the area in the right-of-way within four (4) feet back of the curb shall be graded so that water drains to the street at a minimum grade of 1 inch per foot (approximately 8 percent). In the area reserved for sidewalks and/or driveways (i.e., four (4) to eight (8) feet back of the curb in single or two-family areas or four (4) to nine (9) feet in multi-family or commercial areas), a minimum final grade of 1/4 inch per foot (approximately 2 percent) toward the street is required. For streets with or without curb and gutter or sidewalks which include side ditches, refer to typical section within Appendix "C". All grading behind the street shall be done in a fashion that does not allow ponding of water adjacent to the paved street. For lots that drain away from the street, the area in the right-of-way within

four (4) feet back of the curb shall be graded so that water drains away from the street at a minimum grade of 1/2 inch per foot (approximately 4 percent).

b. Lot areas outside of the limits of the building structure shall be graded toward or away from a point four (4) feet back of the curb so that water drains away from the building at a minimum grade of 1/4 inch per foot (approximately 2 percent) toward the street or into swales or natural drainage areas.

(1.) Topsoil: If grading results in the stripping of topsoil, topsoil shall be uniformly spread over the lots as grading is finished.

(2.) Trees: As many trees as can be reasonably utilized in the final development plan shall be retained, and the grading adjusted to the existing grade of the trees where practicable.

c. Swales carry surface runoff from roofs, yards, and other areas to the rear of lots or along common property lines to streets or other drainage areas to prevent ponding of water near building structures or other portions of the lot. Surface drainage swales shall have a minimum grade of two (2) percent and shall be constructed so that the surface water will drain onto a street, storm inlet, or natural drainage area. Swales for handling lot drainage shall be constructed as a part of final lot grading and be seeded and mulched or sodded as soon as possible to prevent erosion.

d. Roof downspouts, footing, or foundation drains, and sump pumps shall be discharged onto the same parcel of land from which the water is generated. Roof downspouts shall be piped to natural drainage areas away from the street or onto concrete splash blocks, which direct water away from the building structure into swales or other natural drainage areas. Except as permitted by adopted policy within residential property regimes, downspouts or other subsurface drains constructed toward the street shall be discharged on the surface as far back onto the lot as possible and in no case be closer than 20 feet back from the nearest curb of the street. Roof and subsurface drains shall not be connected thru the curb or into the gutter section of the street. Any connection into a storm sewer or catch basin must be approved by the inspector.

F. DESIGN CRITERIA OF STORM WATER RUNOFF CONTROL FACILITIES

1. GENERAL CRITERIA

In order to minimize runoff damage to downstream properties, sediment pollution of public and private waters, and hydraulic overloading of existing drainage facilities, the peak storm water discharge from a land disturbing activity or development and redevelopment activities after development shall

not exceed the peak pre-development discharge from that activity for the 2, 10, 25, and 50-year storm events. Storm water runoff control facilities are required for all land uses including single and multi-family residential, mobile home park, urban and rural commercial, shopping center, professional office, planned unit development, mixed land use, research park, institutional, industrial, and public facilities. Such facilities are also required for other activities that include impervious surfaces that generate increased runoff requiring storage in accord with these regulations. These facilities may be designed for each individual site, but the use of regional facilities is encouraged. These shall be designed so that no standing water will remain in detention facilities during dry weather, or that standing water in retention facilities will not be allowed to stagnate and present health hazards. The use of other methods of controlling peak discharge rates such as bioretention swales and structures and created wetlands are encouraged by the Planning Commission. The amount of water to be detained shall be determined by the methods described in the following paragraphs using the design criteria as referenced in Section C.

2. DESIGN METHODS

An accepted method that generates an inflow/outflow hydrograph such as the Soil Conservation Service (SCS) method or Modified Rational Method (MRM) as detailed in Section 300 shall be used. It is recommended that a computer program be used to develop these hydrographs. All documentation shall be submitted for review by the planning commission's duly authorized representative.

3. DISCHARGE HYDROGRAPHS

For project sites where the pre-development peak discharge has been calculated by the Rational Method, a discharge hydrograph must be calculated for the site using one of the methods allowed in Section 300. Unlike the Modified Rational Method (MRM), the SCS Method uses the Type II rainfall distribution based upon the 24-hour steady storm duration.

4. DESIGN STORMS

The pre-development site runoff shall be calculated for the 2, 10, 25, and 50-year storm frequency. The entire acreage contributing to the runoff shall be included in the calculations.

5. POST-DEVELOPMENT RUNOFF

The post-development site runoff shall be calculated for the ultimate development for the site based on the 2, 10, 25, 50 and 100-year frequency storm. The entire acreage contributing to the runoff shall be included in the calculations.

6. BASIN STORAGE VOLUME

The minimum basin storage volume shall be the difference between the post-development and pre-development 50-year storm inflow and outflow hydrographs, or the volume necessary to sufficiently reduce post-development discharges to a rate needed to meet the capacity of existing culverts and

drainage systems immediately downstream of the site proposed for development. If the basin is to be located directly on a portion of the through drainage system, volume calculations must also consider the total system flow reaching the basin. If the Modified Rational Method is used by computer program, the storm duration used shall be the one that produces the maximum storage, if calculating by hand the duration shall be greater than the time of concentration.

7. OUTLET STRUCTURES

The discharge from the detention/retention basin shall be controlled by a multi-stage release outlet structure and not be greater than a pre-developed runoff rate based on a 2, 10, 25, and 50-year storm frequency at that particular point where the discharge occurs. The emergency spillway shall be sized to accommodate a flow equal to the 100- year storm post-development discharge. The routing of an emergency spillway shall be shown based on the 100-year storm frequency. Trash racks shall be installed on the low flow outlet in detention basins. For basins installed on a FEMA-regulated drainage system as shown on FEMA Flood Insurance Rate Maps (FIRMs), water surface profile for maximum storage shall be in accordance with FEMA guidelines for the appropriate watershed.

8. DESIGN STANDARDS

These standards apply to permanent and temporary storm water runoff, sediment, and debris basins formed by an embankment, or excavation. These standards are limited to the installation of basins on sites where failure of the structure will not result in loss of life, damage to adjacent properties, or interruption of use or service of public utilities; the area draining to the structure does not exceed 200 acres; and the water surface at the crest of the emergency spillway does not exceed five (5) acres.

1. All basins that shall be designed and built with side-slopes no greater than 3:1 (three feet horizontal per one foot vertical), paved channel bottoms and proper outlet structures to insure no standing water during dry periods.
2. The dam crest elevation shall not be less than one (1) foot above the emergency spillway invert or overflow elevation.
3. Discharge velocities within pipe must be controlled to same requirements as specified in Section D. Erosion control linings for open channels must comply with requirements in Section E.
4. Storage, discharge, and routing calculations for the 2-year, 10-year, 25-year, 50-year and 100-year discharges must be submitted for review.
5. Spillways shall be protected from erosion and shall employ energy dissipation, if necessary.
6. Detention basins shall be fully discharged within 36 hours of the storm event.
7. Fencing may be required by the Planning Commission's duly authorized representative or local governments when the location of the detention area is not easily observed or the side slopes of the basin are steeper than 4:1 (four feet horizontal per one foot vertical).

8. If required, ponds shall have dams and spillways that conform to the current Design Criteria for Dams and Associated Structures, Kentucky Division of Water. In cases when the top of the dam is also a publicly dedicated street right-of-way, the developer shall have a geotechnical report prepared with recommendation on the design and construction of the dam.
9. The designer shall include anti-seep collars, baffles, and outlet protection, when required.
10. Maintenance accessibility and responsibility for maintenance shall be included.

9. ROUTING OF STORM HYDROGRAPH THROUGH THE FACILITY

Hydrographs for the 2-year, 10-year, 25-year, 50-year and 100-year storm events shall be routed through the proposed storm water management facilities using the Modified Puls method or another method approved by the Planning commission's duly authorized representative. A request for approval of an alternative method should be submitted to the Planning commission's duly authorized representative prior to running the model and shall be reviewed on a case-by-case basis.

10. PARKING LOT STORAGE

Parking lot storage involves shallow ponding in a specifically graded area of a parking lot. The major disadvantage is the inconvenience to users during the ponding function. Clogging of the flow control device and icy conditions create maintenance and safety problems. This method is intended to control the runoff directly from the parking area and is not appropriate for storing large volumes. Parking lot storage shall generally be limited to those areas served by combined sewers; primarily in the extremely urbanized areas of the counties. Parking lot storage may be approved in separate sewer areas on a case-by-case basis.

General design requirements include:

1. Maximum water depth - 8 inches.
2. Minimum distance of ponding area from buildings - 10 feet.
3. Maximum surface slope - 5.0%
4. Minimum surface slope - 1.0%
5. Maximum discharge to combined sewer system - 10-year pre-development discharge.

12. MAINTENANCE RESPONSIBILITIES

Unless dedicated to and accepted by a legislative body, the owner of each lot and/or the developer of each subdivision shall be responsible for properly maintaining each storm water runoff control facility in order for such facility to function according to its design and purpose. Maintenance provisions for the facility shall be noted on the submittal plans, including access roads. If publicly dedicated, the facility shall be included within the right-of-way and shown on the Final Plat submitted to the appropriate city/county. In residential subdivisions, all facilities shall be deeded to the appropriate legislative body and the area shall be shown as a Lot on the Final Plat. For any retention basin, only the appropriate inlet structures and outlet structures shall be dedicated to

the appropriate legislative body. The area of the pond or lake shall be owned and maintained by the adjoining residents. This shall include maintaining the shoreline and removing sediment, and shall be included in the Subdivision's Restricted Covenants, if applicable. For storm water runoff control facilities that are accepted for maintenance by a city or county and require special maintenance activities, such as undisturbed natural buffer areas, specific maintenance procedures shall be included in the transfer agreement.

13. WAIVERS FOR STORMWATER RUNOFF CONTROL FACILITIES
Certain factors, variations, and/or options will be considered in granting waivers for on-site storage design as part of the review process at the Stage I/Preliminary Plat, Improvement Drawings and Specifications and/or Stage II/Site Plan stages. Waivers granted will be determined from the following:

a. All agricultural uses unless otherwise required by other federal and/or state agencies regarding storm water regulations as "permitted".

b. All single-family residential developments having a minimum lot size of at least one (1) acre or greater provided that the increase in runoff calculated using runoff curve numbers (RCN) or runoff coefficients (C) does not cause problems, deficiencies and damages in the length of channels or reaches downstream determined by a hydrograph based upon the time of concentration or duration of the design storm required. In any development where a storage design is required credits are prohibited. Post - Development runoff curve numbers (RCN) or runoff coefficients (C) may not be less than pre - development runoff curve numbers (RCN) or coefficients (C).

c. Where increased runoff from a development flows into a pre-existing downstream storage facility and routing channels and storage capacity through such facilities are analyzed and improvements made, where necessary or required.

d. Where mitigation of known on-site or off-site deficiencies are determined, engineered and resolved by the sub divider or developer in cooperation with all applicable jurisdictions impacted as assurance that increased runoff will be adequately handled or dissipated without cause for damage during the design storm required.

e. Where a determination has been made that regional storage design beyond the site in question is necessary, equivalent cost of requirements for on-site detention/retention storage may be substituted for immediate construction in the form of a Regional Facility Fee as calculated based on a policy of the planning commission included within its By-Laws.

f. Where off-site/downstream improvements are required to remedy culvert/channel deficiencies determined by runoff calculation methods and/or a hydrograph, such improvements shall be submitted as part of

Improvement Drawings and Specifications and approved for construction prior to approval of a Final Plat or Site Plan.

g. Where detention/retention storage design is not appropriate due to result of hydrograph analyses, and peak discharge and runoff volumes do not pose a problem or result in damages within the length of open channel or closed conduit determined by the time of concentration or duration of the design storm required.

h. Buildings and their related parking areas and other structures where less than two (2) acres of land is to be altered by grading, draining, removing existing ground cover or paving; and, of which 1/2 acre or less will be impervious acres such as roofs, walks, and parking areas. However, this waiver is based upon the stipulation that such impervious hard surfaces are an isolated part of drainage area and not a part of the same drainage or watershed area contributing to an accumulated and combined discharge exceeding the downstream discharge/runoff control requirements of these regulations.

SECTION 7.1 SANITARY SEWER SYSTEM: Except as herein provided, the subdivider shall construct a sanitary sewage collection system designed to serve adequately all lots in the subdivision plus lines adequate in size to facilitate the orderly development of nearby land which is an integral part of the neighborhood service or drainage area (see Section 7.7 of these regulations) and connect said collection system to a centralized sewerage system, or an approved package treatment plant (surface discharge).

A. PLANS REQUIRED: The subdivider shall submit plans and specifications prepared by a registered professional engineer, showing the proposed sanitary sewerage system and facilities. Said plans shall show pipe sizes, gradients, type of pipe, invert elevations, location and type of manholes, the location, type and size of all lift or pumping stations, location, type and capacity of all proposed package treatment plants, and all construction details including such information as required by the planning commission's duly authorized representative.

B. DESIGN STANDARDS: Where applicable, the design criteria for the sanitary sewerage system shall comply with the following published standards, regulations or laws, as applicable:

a. "Recommended Standards for Sewage Works" prepared by the Great Lakes-Upper Mississippi River Board of State Sanitary Engineers, Health Education Service, Inc., Albany, New York, 1978; and
b. State Water Laws and Regulations, and other state statutes, as applicable.

C. MATERIAL AND CONSTRUCTION SPECIFICATIONS: Material and construction specifications, including testing requirements for all sanitary sewer projects shall be in accordance with the Rules and Regulations of the applicable sanitation district or other authority, except as herein provided.

D. INDIVIDUAL ON-SITE SEWAGE DISPOSAL SYSTEMS:

1) Where proposed development is presently not served by a public sanitary sewer system, and is not located within a reasonable distance of an existing or proposed sanitary sewer line as determined by the planning commission or its duly authorized representative, on-site sewage disposal systems may be permitted provided that such systems shall be designed and constructed in accordance with the regulations of the applicable state and local agencies.

2) In the event that existing or proposed sanitary sewer lines are located within a reasonable distance of the site, as determined by the Planning Commission or its duly authorized representative, then said site shall be connected to the public sanitary sewer system. Where permitted under these regulations, all such systems shall also be approved by the appropriate agencies.

SECTION 7.2 WATER SYSTEM: It shall be the responsibility of the subdivider to contact the applicable water district or other applicable water service agency, indicating their proposed layout of the water distribution system, according to the subdivision procedures identified in Article III of these regulations. The subdivider shall design and construct a complete water distribution system which shall serve adequately all lots within the proposed subdivision plus coordinated with the applicable water district, lines adequate in size to facilitate the orderly development of nearby land which is an integral part of the neighborhood service area. Where proposed development is presently not served by a public water system, and is not located within a reasonable distance of an existing or proposed public water system as determined by the Planning Commission or its duly authorized representative, a connection to a public water system is not required.

A. PLANS REQUIRED: The subdivider shall submit plans and specifications prepared by a registered professional engineer, showing the proposed water system. Said plans shall show line sizes, type of pipe, location of hydrants and valves and other appurtenances, if applicable, supply facilities, booster pumps, elevated or ground-level storage tanks, including all construction details.

B. DESIGN STANDARDS: The design criteria for the water distribution system shall be based upon regulations of the applicable water district, and the following requirements:

1. MINIMUM FIRE FLOWS

(a) MINIMUM FIRE FLOWS: The minimum fire flow in areas served by a public water system is 500 gpm (gallons per minute) at 20 psi (pounds per square inch) residual pressure unless otherwise approved in writing by the applicable fire district's fire chief.

Minimum fire flow from a source shall be determined from an adequate fire flow test described below within Section 7.2 B, 2. Minimum fire flow will be utilized by the applicable water district and/or planning commission as a requirement for approval of any proposed Preliminary Plat requiring a public water supply.

(b) ADDITIONAL REQUIREMENTS: The Insurance Services Office (ISO) Guideline Fire Suppression Rating Schedule for safety and consumer protection is recognized as a goal for levels of fire flow in residential subdivisions. Upon determination by the Planning Commission, that it is practicable for the purpose of increasing the fire flow above the minimum required within subparagraph (a) above, based upon economic feasibility in proportion to the development, any of the following can be required as a condition/requirement for approval of any proposed Preliminary Plat requiring a public water supply:

(1) Upsizing or replacement of any existing off-site water system facility or infrastructure; and/or
(2) Construction of circulation or interconnection with another water system; and/or
(3) Providing other alternative water supply sources.

2. FIRE FLOW TESTING: Available fire flow in an area proposed for development shall be determined from an adequate fire flow test performed by the applicable water district, qualified consultant and/or fire department. Fire flow testing shall conform to standard procedures as recommended in the National Fire Protection Association (NFPA) Fire Protection Handbook including the following: (a) static and residual pressures in pounds per square inch using a hydrant cap or hose cap drilled for a pressure gauge; (b) internal diameter of flowing hydrant nozzle orifice in inches, discharge coefficient and recorded pressure using a pitot gauge; and (c) available fire flow in gallons per minute at a residual pressure of 20 pounds per square inch.

3. WATER MAIN SIZES: Upsizing of water distribution mains for primary transmission and/or secondary feeders shall be based upon the applicable water district's master plan, where applicable.

4. FIRE HYDRANT LOCATION/SPACING: Hydrants shall be spaced so as to be not more than 450 feet between hydrants in residential areas of one and two-family dwellings and not more than 300 feet between hydrants in areas of high volume or high density unless otherwise approved in writing by the applicable fire district's fire chief.

The location/spacing of fire hydrants relate to lengths along streets, drives, yards, etc., as fire hose is placed. All deadended systems are subject to approval by the applicable water district.

C. MATERIAL AND CONSTRUCTION REQUIREMENTS: Material and construction specifications, including testing requirements for all water distribution systems, shall be in accord with the rules and regulations of the applicable water district, where applicable.

SECTION 7.3 STREETS:

A. PLANS REQUIRED: The subdivider shall submit plans and specifications prepared by a registered engineer showing the proposed street system. Said plans shall show the proposed right-of-way width, pavement width, location and the proposed alignment, grade, geometric details and typical cross-sections of each proposed street, including curbs and gutters and sidewalks (where applicable). Said plans and specifications shall show for each proposed street, design criteria such as street classification, pavement classification and thickness and classification and thickness of base and subbase materials.

In addition, the following information shall be required:

1. The plans and profiles of all surrounding streets which are to connect to a street in the proposed subdivision (for a distance of one hundred (100) feet back from the boundary line of the proposed subdivision).

2. All profiles shall be drawn at a scale not to exceed one inch = 50 feet (horizontal) and one inch = 10 feet (vertical).

3. Existing and proposed grade elevations shall be shown at all regular station points including vertical sag P.I.(s), P.C.(s) and P.T.(s) and percent grade between P.I.

4. Elevations shall be tied to a bench mark (U.S.G.S. or other bench-marks when available), when, within a reasonable distance (as determined by the planning commission's duly authorized representative) and shall be shown on the Improvement Drawings and Specifications.

5. Details of curb and gutter, sidewalks, street section and paving shall be shown.

B. PAVEMENT SPECIFICATIONS: All streets shall be paved with Portland Cement concrete or asphalt concrete and constructed in accordance with the specifications in Appendix "A" or "B" (whichever is applicable) of these regulations.

C. MINIMUM PAVEMENT WIDTHS: Pavement widths shall be measured from back of curb to back of curb, or if no curbs are required, then measurements shall include the entire paved surface. Minimum pavement widths for each street shall be as shown in Table 3 and laid out in the manner indicated by the typical street cross sections shown in Appendix "C".

D. CURBS AND GUTTERS: The subdivider shall construct vertical curbs, for all residential streets (where applicable) as identified in Table 3. For streets to be constructed of asphalt concrete, curb and gutter shall be constructed according to the typical section detail in Appendix "C".