

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 purposes 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 Storm 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.

$$Q = CiA$$

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.

<i>Table 2 - Rational Method Runoff Coefficients for Composite Analysis</i>		
Land Use Description	Average Percent Imperviousness	Runoff Coefficient (C)
Natural and Undisturbed Areas	Varies	0.4
Single Family Residential	Varies	0.43-0.76
Average Lot Size/Width	(See Below for Value)	(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 in 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 'O' 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 city of Falmouth or other applicable Sanitation District, 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".

All curbs and gutters shall be constructed of Portland Cement concrete and in accordance with the specifications in Appendix "A" and typical cross-sections in Appendix "C".

E. CURB RADII: The minimum curb radius at intersections shall be as follows:

TYPE OF STREET* INTERSECTION	MINIMUM CURB RADIUS (IN FEET)
Local - Local or Subcollector	25
Subcollector - Subcollector	25
Subcollector - Collector	30
Collector - Collector	30
Arterial - Arterial	**

* In the case of local or collector streets located in commercial or industrial areas, the minimum curb radii shall be increased to fifty (50) feet.

** Shall be based on current design standards of the Kentucky Department of Transportation.

F. SIDEWALKS: Sidewalks shall be required as identified in Table 3 of these regulations. The planning commission may grant a modification or waiver to the sidewalk regulation, providing the planning commission shall find: a) that the proposed development contains a minimum density of one (1) dwelling unit per two (2) net acres and / or lots with 200 foot frontage widths; and b) that the development or request will generate low traffic volumes without adversely jeopardizing pedestrian safety; and c) that the provision for sidewalks abutting existing streets or roadways or other roadways is impracticable, unnecessary or will contribute to an attractive nuisance or other safety hazard further regulated by Section 8.5 of these regulations.

Alternative pedestrian walkways to those identified in Table 3 of these regulations may be permitted by the planning commission provided such alternative(s) are determined to constitute an integral pedestrian circulation system equal to, or exceeding the requirement for sidewalks along both sides of a street. Such alternative pedestrian walkways may be within the public right-of-way, outside the public right-of-way within a public pedestrian circulation easement, or combination thereof. Pedestrian walkways within the public right-of-way shall be constructed of Portland Cement Concrete in accordance with the specifications of Appendix "A" of these regulations, at least four (4) inches thick and increased to five (5) inches of thickness when included as part of a driveway. Pedestrian walkways along the street shall be laid out in the manner indicated by the typical cross-sections shown in Appendix "C". Pedestrian walkways outside the public right-of-way determined to be a part of the integral pedestrian circulation system are permitted to be Asphaltic Concrete provided they are in accord with Appendix "B", or approved

equal, a minimum of five (5) inches thick and proof-rolled prior to placement of the Asphaltic Concrete. All pedestrian walkways determined to be a part of the integral pedestrian circulation system shall be constructed with a minimum width of four (4) feet in single-family residential areas, and five (5) feet in multi-family residential and commercial areas, where pedestrian traffic volume indicates the need for this additional width. Pedestrian walkways outside the public right-of-way determined not to be a part of the integral pedestrian circulation system are not regulated herein, however such pedestrian walkways may be regulated by other applicable agencies or law(s) (i.e. Americans with Disabilities Act).

1. Handicap Accessible Curb Ramps

Where sidewalks along streets are required, curb ramps or other hard surfaced pavements shall be installed at all new street intersections in accord with the U.S. Department of Justice's regulation of the Americans with Disabilities Act of 1990. Sidewalk Ramp types shall comply with Details indicated within Appendix C, where applicable. All ramps shall be designed (which may include additional inlets) to prohibit excessive stormwater from flowing onto ramps causing further safety and maintenance problems for use of such facilities.

- G. **PARKING:** Parking on any street where pavement width is less than thirty-six (36) feet shall be limited to one side of the street, except as otherwise noted within Table 3. Parking lanes shall not be shifted from one side to the other from block to block or where the proposed street is the extension of an existing street the parking lane shall extend continuously on the same side of the street. If practicable, the parking lane shall be located on the opposite side of the street from where the fire hydrants are located.
- H. **CUL-DE-SAC AND DEAD-END STREET:** Cul-de-sac courts and dead-end streets shall be designed in accordance with the typical design details as per Appendix "C" of these regulations. However, if conditions warrant, other turnaround designs may be permitted by the planning commission or its duly authorized representative. If such street is of a temporary nature and a further extension into adjacent land is anticipated, then said turnaround, beyond normal street width, shall be in the nature of an easement of the premises included in said turnaround, as per the typical design in Appendix "C". Such easement may be vacated to abutting property owners when said deadend street is legally extended into adjacent land. If such deadend street serves four (4) lots or less, no temporary turnaround will be required.
- I. **CONSTRUCTION OF REQUIRED PAVEMENT WIDTH ON EXISTING STREETS:** When a subdivision is located on only one side of an existing street, and where the pavement width of such existing street is less than that required by these regulations, the subdivider may be required to construct one-half (1/2) the required pavement width, as per these regulations, along the side fronting his property on such street.

J. INTERCONNECTION/EXTENSION

1. The arrangements of streets in new subdivisions with an existing street or streets or adjacent undeveloped land shall make provision for projection of streets to those adjoining areas in a timely fashion as required with approval of a Preliminary Plat, per Section 3.3 of these regulations.
2. Improvement Drawings and Specifications for interconnection with an existing street or extension to adjoining land shall be submitted for approval and construction when either one of the following conditions exist:
 - a. At least twenty-five percent (25%) of the lots or units approved as a Preliminary Plat or ten (10) lots or units, whichever is less, remain unplatted without construction of improvements and a secondary interconnection or extension to adjoining land; or
 - b. The terminus or stub of a street constructed in a new subdivision is 300 feet or less from such interconnection or projected terminus at the adjoining land.

Determination of compliance shall be made by the planning commission's duly authorized representative prior to approval of any new phase of Improvement Drawings and Specifications or individual Section of a Final Plat within the subdivision.

3. Final Plat for interconnection or extension shall include street right-of-way dedication to public use abutting existing street right-of-way or adjacent undeveloped land. Remnants of land, devil or spite strips are prohibited.
4. A guarantee may be filed with the planning commission's duly authorized representative in lieu of actual installation or completion of the required public improvements per Section 7.12 of these regulations.

SECTION 7.4 DRIVEWAY APPROACHES: Driveways for residential areas shall be provided with a minimum width as follows: one (1) lot or residence - nine (9) feet, or twelve (12) feet where the length of a driveway is 150 feet or more; two (2) lots or residences - twelve (12) feet; three (3) or four (4) lots or residences - sixteen (16) feet; each increasing in width by four (4) feet at the curb (i.e., two (2) foot flare or taper on each side of driveway) for court, cul-de-sac, local, sub collector and collector streets. In areas of heavier traffic volumes or where special conditions are encountered (Multi-Family, Industrial, Commercial areas), increased driveway widths, plus increased minimum radii or flares may be required by the planning commission, or its duly authorized representative. Except for driveways in transition from upward to downward slopes, all driveways within the right-of-way shall be constructed in accordance with standard construction details within Appendix "C" and the specifications of Appendix "A" or "B" (whichever is applicable) of these regulations. As an alternative to Section 7.3 F, driveways, aprons and sidewalks within driveway aprons may be constructed of other building materials including colored concrete stampings, solid brick, pre-manufactured pavers or other similar hardened materials, provided such construction complies with the minimum standard specifications

for sub-grade, strength and impermeability. Within the street right-of-way area, grades for upward sloping driveways within four (4) feet of the curb shall not be less than 1 inch per foot (approximately 8 percent) nor more than 2 inches per foot (approximately 16 percent). Grades for downward sloping driveways within four (4) feet of the curb shall not be less than 1/2 inch per foot (approximately 4 percent) nor more than 2 inches per foot. Sidewalks included as part of driveways or separate there from shall not be less than 1/4 inch per foot (approximately 2 percent) nor more than 1/2 inch per foot. Grades for upward or downward sloping driveways between edge of sidewalk and right-of-way line shall not be less than 1/4 inch per foot nor more than 2 inches per foot.

SECTION 7.5 STREET SIGNS:

- A. **STREET NAME SIGNS:** The developer, in conformance with standards established by the applicable legislative body or fiscal court shall be responsible for the installation of Street Name Signs prior to approval of a Final Plat. Street Name Signs shall conform to minimum standards contained within the "Manual on Uniform Traffic Control Devices", latest addition. In general, Street Name Signs shall be constructed on a single post located along the right side of the roadway at all intersections approximately two (2) feet from the pavement or curb at a height of seven (7) feet. Lettering on Street Name Signs should be at least 4 inches high. Suffixes may be in smaller lettering at least 2-inches high. A temporary sign is permissible until the permanent sign is erected.
- B. **TRAFFIC CONTROL SIGNS AND DEVICES:** The applicable legislative body or fiscal court shall arrange for the installation of traffic control signs and devices which shall be in conformance with the "Manual on Uniform Traffic Control Devices" as prepared by the Joint Committee on Traffic Control Devices, U.S. Department of Commerce, Bureau of Public Roads, as amended.

SECTION 7.6 MONUMENTATION:

- A. All corners of the boundary survey shall be monumented or witness monumented. Every monument set shall be of a type or character having a degree of permanency consistent with that of the local terrain and physical features. Wherever possible, monuments shall be made of a permanent material that makes it possible for the monument to be detected by a device capable of finding ferrous or magnetic objects. Types of acceptable monuments include, but are not limited to, iron pipes, iron pins, iron rods, re-bars, chiseled crosses, railroad spikes, mine spikes, P.K. nails and drill holes. Wooden stakes shall not be use as monuments. Each iron pipe, iron rod, iron pin or re-bar monument set by a land surveyor shall bear his registration number on a manufactured cap or identifier.
 - 1. Existing permanent manmade or natural features are acceptable monuments. Where manmade or natural features are subject to change, realignment or misinterpretation, such monuments or features shall be "witness monumented."

2. "Witness monumentation" shall be used when it is not possible or practicable to set the actual corner. Whenever witness monumentation is used, it shall be placed "on line" if possible and shall be shown on plats and called for in descriptions.

B. OTHER MONUMENTS: Other monuments set shall be metal pins of no less than one-half (1/2) inch diameter and no less than twenty-four (24) inches in length. Monuments of this type shall be set at all of the following locations:

1. At every point of intersection of the outer boundary of the subdivision with an existing or created right-of-way line of any street, railroad, or other way.

Appropriately identified markings shall also be located at each point along the street curb which intersects with the side lot lines of each lot.

SECTION 7.7 PLANS FOR FUTURE EXPANSION - EXTRA SIZE AND OFF-SITE IMPROVEMENTS: All improvements shall be installed to satisfy the service requirements for the service or drainage area in which the subdivision is located and the improvements shall be of sufficient capacity to handle the expected development of the overall service or drainage area involved.

EXTRA-SIZE IMPROVEMENTS: Where the planning commission's duly authorized representative has determined that improvements in excess of the size needed to serve the proposed subdivision are required, and are determined by the planning commission to be economically feasible in proportion to the development, the planning commission can require additional improvements above the minimum standards set forth herein.

SECTION 7.8 PLANS REQUIRED FOR GRADING AND CONTROL OF EROSION AND SEDIMENTATION: Any developer who intends to make changes in the contour of any land proposed to be subdivided, developed, or changed in use by grading, excavating, or removing the natural topsoil, trees, or other vegetative covering thereon, shall submit a plan for grading and erosion and sedimentation control to the planning commission's duly authorized representative for approval.

Such plans, if required, shall contain adequate grading measures including the control of erosion and siltation where necessary, using current acceptable guidelines and requirements contained herein.

A. REQUIREMENTS:

1. One (1) set of plans for grading and the control of erosion and sedimentation shall be submitted to the planning commission's duly authorized representative, as per the procedures established in Article III.
2. In the event the planning commission's duly authorized representative recommends final plat approval before construction of improvements, as per Section 3.9, A., 2., measures to be taken to control erosion and

sedimentation shall be included, in the plans above as provided as per these regulations.

3. During the construction phase, further technical assistance may be furnished, if requested, by the planning commission's duly authorized representative, or by the local representative of the Natural Resources Conservation Service. However, the planning commission, or its duly authorized representative, shall enforce compliance with the approved plans.
4. The planning commission's duly authorized representative shall make periodic inspections of the methods used and the overall effectiveness of the erosion and sedimentation control program.

B. EARTHWORK GRADING AND EROSION CONTROL MEASURES: The following control measures should be used for an effective erosion and sedimentation control plan for the area under development:

1. The smallest practical area of land should be exposed at any one time during development.
2. When land is exposed during development, the exposure should be kept to the shortest practical period of time.
3. Where necessary, after grading, temporary vegetation and/or mulching should be used to protect areas exposed during development.
4. Sediment basins (debris basins, de-silting basins, or silt traps) should be installed and maintained until ground cover has been completed to remove sediment from runoff waters from land undergoing development.
5. On-site provisions should be made to effectively accommodate the increased runoff caused by changed soil and surface conditions during and after development.
6. The permanent final vegetation and structures should be installed as soon as practical in the development.
7. The development plan should be fitted to the topography and soils so as to create the least erosion potential.
8. Wherever feasible, natural vegetation should be retained and protected.

SECTION 7.9 CONSTRUCTION INSPECTIONS:

A. AUTHORITY AND DUTIES OF INSPECTORS: Inspectors are authorized to inspect all work done and all materials furnished. Each inspector shall have one (1) complete set of all plans and specifications with certified approval by the planning commission's duly authorized representative. Such inspection, including final

inspection, may extend to all or any part of the work and to the preparation, fabrication, or manufacture of the materials to be used. Except for minor deviations, the inspector shall not be authorized to revoke, alter, or waive any requirements of the approved plans related to grading, public improvement construction, erosion control plans, and Improvement Drawings and Specifications. Contractors shall notify the inspectors at least 12 hours prior to the time when the work is to begin on each phase of construction, including erosion control, earthwork related to public improvements, storm sewer systems, sanitary sewer systems, street paving and driveway/sidewalks including all related testing, etc., where applicable.

The inspector shall commence inspections at the time of work starts and continue inspections necessary and appropriate in the circumstance as the work progresses on each phase of the project until all construction is complete. Any work determined by the inspector not to conform to the requirements of the approved Grading Plans including erosion control, and Improvement Drawings and Specifications or other requirements of these regulations shall be suspended and such construction brought into conformance with plans and standards as approved.

When minor deviations regarding design or construction specifications are observed during on-site inspections, the planning commission's duly authorized representative, has been delegated certain discretionary judgment. Prior to permitting a minor deviation, the planning commission's duly authorized representative's judgment shall include findings that such deviation(s) will not be: a) in conflict with the intent and purpose of these regulations; b) in dispute with a majority of generally accepted AASHTO or ASTM industry standards or other standards regarding engineering judgment as determined by the planning commission's duly authorized representative, where applicable; and c) detrimental to the public interest. Where such deviations are permitted, the planning commission's duly authorized representative may require a guarantee or warranty for the construction at issue for a time period not to exceed twelve (12) months.

The planning commission's duly authorized representative reserves the right to order items removed and replaced and/or additional testing when work was performed contrary to approved plans and specifications, or without adequate notification for inspection. Following final inspections of improvements, the planning commission's duly authorized representative shall certify, in writing, to the applicable cities and/or fiscal court, that improvements have been constructed in accord with grading plans including, erosion control plans, and Improvement Drawings and Specifications and inspected per these regulations, if such is the case.

SECTION 7.10 CONSTRUCTION RESPONSIBILITIES:

- A. **COOPERATION OF SUBDIVIDER AND/OR CONTRACTOR:** The subdivider and/or contractor(s) shall have available on the project, one (1) complete set of all plans and specifications, as approved by the planning commission's duly authorized representative and other local and state government agencies, where "permitted". Contractors shall cooperate with the inspector and with other contractors in every way possible. The subdivider and/or contractor shall, at all times, during actual

construction, have a competent superintendent acting as his agent on the project. The superintendent shall be capable of reading and thoroughly understanding the plans and specifications and he shall receive instructions from the inspector. The superintendent shall have full authority to execute the orders or directions of the inspector. A superintendent shall be furnished irrespective of the amount of work sublet. Subdividers and contractors are not relieved of other responsibilities and requirements of other state and local agencies relating to zoning, permits, etc., which may be beyond the scope of requirements of the Subdivision Regulations. Satisfactory completion of inspections and certification that improvements have been constructed in accord with grading plans, erosion control plans, and improvement drawings and specifications per these regulations, shall not be a defense in an action for damages against anyone who may be liable by reason of non-compliance with the requirements of these regulations.

SECTION 7.11 FINAL CLEANING UP: Upon completion of the work, the subdivider and/or contractor shall clean up all ground occupied or affected by him in connection with the work.

SECTION 7.12 AGREEMENTS AND GUARANTEES:

- A. **GUARANTEES:** The subdivider may execute and file guarantees with the planning commission's duly authorized representative, in lieu of actual installation or completion of the required improvements, except sidewalks, when requesting approval of the final plat. In the case where sidewalk improvements have not been completed (i.e., construction of sidewalks as regulated herein are the responsibility of the builder and owner of the lot in question and are not required to be completed or guaranteed prior to final plat approval), a conditional certificate of occupancy may be given by contract with the applicable legislative body or fiscal court not to exceed six (6) months signed by both the builder and owner of the premises for which the improvements will serve.

Guarantees, shall be based on a cost estimate for the required improvements, for each phase of uncompleted construction as estimated by the subdivider's engineer. Such guarantees shall run to the planning commission and be acceptable by the planning commission's duly authorized representative and the commission's legal counsel. The cost estimate shall be based on the amount determined to be reasonably necessary to complete all of the improvements required to be constructed by the subdivider, as specified in the approved improvement drawings and specifications, including a ten (10) percent contingency plus engineering fees and the fees for plan review and construction review as established by the By-Laws.

Except as herein provided, the guarantee shall be in the form of a good and sufficient surety bond, executed by the subdivider as principal, and a corporation authorized to act as a surety under the laws of the state of Kentucky, as surety. The guarantee shall be an assurance of faithful performance of any and all work and the construction and installation of all improvements required to be done by the subdivider, as specified in the approved improvement drawings and specifications,

together with contingency plus all engineering fees and the fees for plan review and construction review as established by the By-Laws.

Except as required within Section 7.3, J. regarding street interconnection/ extension, the guarantee shall contain the further condition that, should the subdivider fail to complete all work and improvements required to be done by him within twenty-four (24) calendar months of the date of approval of the final plat, or within a mutually agreed upon extension, but never to exceed twelve (12) consecutive calendar months, that the planning commission or its duly authorized representative shall cause all required work to be done and improvements constructed. The parties executing the guarantee shall be firmly bound for the payment of all necessary costs therefore. Whenever the subdivider elects to execute alternative forms of guarantee (i.e., cash, bonds, letter of credit, escrow agreement, etc.), such instruments including the engineer's itemized cost estimate plus contingency, type of surety and amount shall be filed and reviewed by the planning commission's duly authorized representative including the commission's legal counsel prior to approval of such guarantee and a final plat. All guarantees shall include a provision that, in the event of any default on the part of the subdivider or the performance of any work or construction of any improvements for which such guarantees have been deposited, to cause the required work to be done and to withdraw that amount required for payment of all costs therefore.

Following final inspections of improvements guaranteed, the planning commission's duly authorized representative shall so certify in writing to the surety or other guarantee holder regarding such completion to permit the release or return of the guarantee to the subdivider within ten (10) days of such final inspection certification.

**TABLE 3
IMPROVEMENT REQUIREMENTS BY TYPE OF STREET**

TYPE OF STREET	NUMBER OF LOTS SERVED	RIGHT-OF-WAY (ft)	PAVEMENT WIDTH (ft)	CURB AND GUTTER	SIDEWALKS ALONG STREET	ON STREET PARKING	MINIMUM FRONT YARD DEPTH (ft)	OFF-STREET PARKING REQUIRED	MINIMUM LOT WIDTH AT SETBACK (ft)	MINIMUM PAVEMENT THINCKNESS
COURTS										
Deadend										
Typical	Under	40	22	Yes	None	One Side				(C)
Optional	7	50	20	No (A)	None	None	50	4 spaces (B)	100	(C)
CUL-DE-SAC										
Deadend										
Typical	7-25	50	25	Yes	One Side	One Side				(C)
Optional	7-25	50	20	No (A)	One Side	None	50	4 spaces (B)	100	(C)
LOCAL										
Typical	Under	50	25	Yes	Both Sides	One Side				(C)
Optional	100	50	20	No (A)	Both Sides	None	50	4 spaces (B)	100	(C)
SUB-COLLECTOR										
Typical	100-	50	28	Yes	Both Sides	One Side				(C)
Optional	500	50	22	No (A)	Both Sides	None	50	4 spaces (B)	100	(C)
COLLECTOR										
Typical	Over	60	30	Yes	Both Sides	One Side				(C)
Optional	500	60	22	Yes	Both Sides	None	50	4 spaces (B)	100	(C)

Note: Where streets are to serve industrial or commercial areas, the pavement design shall be based on a study prepared by the subdivider's engineer, projecting the type of vehicles using the street, traffic volumes, and recommended pavement design. Such design shall be approved by the planning commission's duly authorized representative.

- (A) Shoulders and side ditches may be permitted and designed in accordance with these regulations provided the minimum front depth is 50 feet, and the minimum lot width is 100 feet.
- (B) Individual off-street parking spaces shall be laid out in such a manner to insure that each space has unrestricted ingress and egress to a public street (i.e., not blocked from gaining access to the street via another parked vehicle).
- (C) Minimum pavement thickness for Portland cement concrete and asphalt concrete shall be designed in accordance with Appendices A and B , respectively.

Note: Arterial streets shall be designed in accordance with the requirements of the Kentucky Department of Transportation.