ARTICLE 8

DESIGN STANDARDS FOR SUBDIVISION IMPROVEMENT PLANS

This article establishes standards for the design of improvements for all subdivisions or other developments within Grant County. The purpose of these standards is to establish minimum design and improvement standards which will be required as a pre-condition to development or in conjunction with development of lots, streets, utilities and other physical elements of a subdivision or development. All plans for improvements must be designed by a Kentucky Licensed Professional Engineer, approved by the Planning Commission and reviewed, inspected by the Planning Commission's Engineer and/or other regulatory agencies, where applicable, in accord with provisions of these regulations.

SECTION 8.1 STORM WATER MANAGEMENT and DRAINAGE SYSTEMS

Storm sewer systems are designed to collect and convey storm water runoff from streets inlets, runoff control structures, and other locations where the accumulation of storm water is unsafe. No storm water shall be permitted to run into a sanitary sewer system within a proposed subdivision. In general, the cumulative amount of storm water runoff discharge from the boundary of a site or subdivision shall be equal in terms of pre-development and post-development. Storm water runoff from a site or subdivision shall not adversely impact natural drainage from an uphill drainage basin or to a downhill drainage basin or adjacent properties. The property owner shall be responsible for storm water drainage facilities located on private property where runoff will be principally collected within that property and be minimally discharged over a larger area before the storm water naturally drains on adjacent properties. For isolated areas of the subdivision, where increased runoff may leave the boundary, downstream conditions must be considered to ensure that the increase runoff will not adversely impact existing drainage structures,

All public maintained storm sewer systems shall be designed for a peak flows calculated on the ten year (10) storm frequency. Overflows shall be designed on the one hundred year (100) storm. Safety swales shall be designed to carry all runoff away from any structure.

A. Basic Design Criteria for a Storm Sewer System

1. Degree of Protection Required – The storm drainage system shall be adequate to handle the runoff from storms having various frequencies of occurrence for various degrees of site development, in accord with the following general categories:

a. Conservation, agricultural and low density Residential (2 acre lots or larger)	10 year frequency
b. All other residential and commercial	10 year frequency
c. Industrial areas	10 year frequency
d. For concentrated high value areas	10 year frequency
e. For flood control facilities	10 year frequency

The runoff computed from these storm frequencies shall be from the area within the site or subdivision and all other areas draining thereto.

2. Determination of Quantity of Runoff for Design of Storm Water Collection System

Each portion of the storm water drainage collection system shall be capable of handling the peak flow of runoff. For drainage areas less than one hundred (100) acres, either the "Rational Method" or "Soil Conservation Service (SCS) Method" may be used. For areas greater than one hundred (100) acres, either the "Soil Conservation Service (SCS) Method" or the "Regional Method" of the Kentucky Transportation Cabinet, Bureau of Highways shall be used.

a. Rational Method:

"Rational Method" where Q = CIA
Q = peak runoff quantity in cubic feet per second
C = runoff coefficient varying with perviousness and other characteristics of the drainage area
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
A = area in acres of the tributary watershed

Runoff Coefficients: The runoff coefficients are the portion of the precipitation, expressed as a decimal that will reach a give storm sewer facility. Each lot within a subdivision contributes runoff from the roof, driveway, sidewalk and street. Generally, the smaller the lot width, the less impervious area. As the lot increases in width so does the impervious area. Weighted coefficient shall be used with the impervious areas C = 0.95 and all other areas C = 0.40.

TABLE 8.1

Rational Method Runoff Coefficients for Composite Analysis

Land Use Description	**Average Percent Imperviousness**	**Runoff Coefficient (C)**
Natural and Undisturbed Areas	Varies	0.40
Single Family Residential Average Lot Size/Width	Varies (See Below for Values	0.43 – 0.76 (See Below for Values)
3 acres/300 feet	6	0.43
2 acres/200 feet	7	0.44
1 acre/100 feet	12	0.47
½ acre/100 feet	23	0.53
12,500 sq. ft./80 feet	34	0.59
9,000 sq. ft./70 feet	42	0.63
7,500 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

Intensity of Precipitation: The “point” values of average precipitation intensity in inches per hour, for Grant County can be determined from Exhibit No. 4-904, Kentucky Bureau of Highways, “Rainfall Intensity-Duration-Frequency Curves”. For any given storm duration (concentration time of runoff) the curves show the average precipitation intensity of storms having 2, 5, 10, 25, 50, and 100 year frequencies or the precipitation intensity can be calculated by using the following formula and constants developed by the Kentucky Transportation Cabinet.

$I_{RI} = B/(T_C+D)^E$

TABLE 8.2

Return Interval (RI)	B	D	E
2	34.5848	6.9000	0.7899
5	54.0284	9.5000	0.8211
10	65.6903	10.6000	0.8262
25	87.9368	12.4000	0.8499
50	100.0737	13.0000	0.8553
100	114.6446	13.8000	0.8614

Time of Concentration: The time of concentration is the time associated with the travel of runoff from the outer point that best represents the shape of the contributing areas. Runoff from a drainage area usually reaches a peak at 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 judgement 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 six (6) minutes.

b. Soil Conservation Method:

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

At no time shall the Time of Concentration be greater than thirty (30) minutes for design of storm inlets.
The Soil Conservation Service (SCS) Method may be used to calculate the peak discharge rates; develop runoff hydrographs for basins and sub basins; determine runoff volumes; and provide inflow information to determine the required storage

volume for detention and retention basins. 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 Grant County, When the Soil Conservation Service methods are used, and the Type II rainfall distribution shall be used.

For detailed information, the user is referred to the following Soil Conservation Service publications:

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

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

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

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

c. Regional Method:

The Regional Method of the Kentucky Transportation Cabinet, Bureau of Highways (Regional Method) may be used to calculate the peak discharge rates 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.

C. Storm Water System Facilities:

1. 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.

2. Pipe Capacities – Public storm sewer pipe shall be designed to carry peak flows as determined by the methods previously described. At 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). For roughness coefficients see Appendix "D", Item 1.1.

3. Minimum Pipe Size – The minimum diameter for public storm sewer pipe shall be fifteen inches (15") and twelve inches (12") for systems with a catch basin at the initial point.

4. Minimum and Maximum Velocities – Velocities in public storm sewer pipes, when flowing full at the average peak flows, shall not be less than two feet (2.0') per second and not greater than forty feet (40') per second.

5. Pipe Grades – The 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. Sewer pipe on twenty percent (20%) slopes or greater shall be anchored securely with concrete anchors or equal, spaced as follows:

a. Not over thirty six feet 36'0 center to center on grades of twenty percent (20%) and up to thirty five percent (35%);

b. Not over twenty four feet (24') center to center on grades of thirty five percent (35%) and under fifty percent (50%);

c. Not over sixteen feet (16') center to center on grades of fifty percent (50%) and over.

6. Hydraulic Grades – To ensure against surface ponding or street flooding due to surcharging, the hydraulic grade line (HGL) of the design storm in any pipe may not be higher than the top of the pipe for the ten year (10 yr.) design storm; and one foot (1') below the inlet or manhole for the twenty five year (25 yr.) check storm.

   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 large pipe. In no case shall storm sewer pipe sizes be reduced unless the upstream pipe is an approved underground detention structure.

7. Manholes (Junction Boxes) – Manholes shall be constructed in accord with Standard Construction Drawings, See Appendix "C". Drop manholes may be required to reduce the slope of any sewer line. Pipes shall not extend more than two inches (2") into the side of the manhole and the invert of the outlet pipe shall be at the bottom of the manhole.

8. Inlets (Catch Basins)

   a. Capacity: The capacity of the grate on the inlet 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. A safety swale designed for the 100 year storm shall be placed at all low points or sags. Curb openings on 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. Pipes shall not extend more than 2 inches (2") into the side of the inlet box, and the invert of the outlet pipe shall be at the bottom of the inlet box.

   b. Type: Combination type inlets (single or double) shall be used and installed in accord with "Standard Construction Drawings", see Appendix "C". Any catch basin not placed on a lot line or within three feet (3") of a driveway shall use a rolled type grate, see Appendix "C". Capacity calculations must be based on the type of inlet. Curb and gutter inlets and shall accommodate the flow from a storm with an intensity of four inched (4") per hour.

c. Location: Inlet spacing shall be based upon gutter and inlet capacity, street slope and contributing drainage area. The spacing of the inlets should ensure that street drainage generated along continuous grades or in sags will not damage and flood private properties or residential basements. For the design storm, no more than 5 cfs shall enter any grade inlet; no more than 8 cfs shall enter any slump inlet and the maximum spread on any street pavement shall not exceed six (6) feet; and no more than 2.5 cfs is permitted to flow in side yards between houses. The maximum spacing between inlets shall be as follows:

1. Along continuous grades (less than 2 percent) – 400 feet maximum;

2. Along continuous grades (2 percent and over) – 600 feet maximum;

3. At sag locations (draining less than 2 percent grades) – 400 feet maximum between inlets or from a high point;

4. At sag locations (draining 2 percent and over grades) – 600 feet maximum between inlets or from high point.

9. Cul-de-sacs

Special consideration should be given to storm drainage entering cul-de-sacs. Additional inlets shall be required when drainage areas and/or streets slopes are excessive. In addition to a inlet provided at 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 following criteria:

a. All street slopes less than eight percent (8%) and draining more than 400 feet of pavement;

b. All street slopes eight percent (8%) or greater and draining more than 300 feet of pavement.

10. Intersections – Storm water runoff crossing the intersection of a street shall be kept to a minimum.

11. Outfalls – When a storm sewer system outfalls into a flood plain of any major water course, the outfall must not be subject to frequent flooding or backwaters. Standard headwalls and/or headwalls with wingwalls shall be constructed for all outfalls. To minimize adverse impacts on receiving channels, one of the following conditions must be met:

a. The outlet velocity at a headwall or outfall of a paved channel shall be less than or equal to the natural velocity of the receiving channel or stream for the design stream but shall not be more than ten (10') feet per second;

b. Structurally lined aprons or other acceptable flow spreading or energy dissipating devices shall be installed at the outlet to reduce the velocity;

c. The receiving channel or stream shall be lined as per Article 8, Section 8.0 - D "Basic Design Criteria for Storm Water Drainage Channels, Water Courses and Erosion Control" of these regulations for a sufficient distance to protect against erosion.

   When a storm sewer or paved channel outlets onto a slope without a defined drainage channel, either a channel shall be graded and properly protected down to its convergence with the natural channel, or the outlet flow shall be dispersed on the slope using acceptable flow spreading or energy dissipating devices. Storm sewers or paved channels that outlet at or near defined drainage channels, shall be designed to outlet at as near to parallel to the channel as practical.

   The outlet velocities of all headwalls shall be included in the drainage calculations. The invert of the first storm sewer appurtenance upstream of the outfall structure shall be above the elevation of the calculated one hundred (100) year flood plain, The calculated one hundred (100) year flood plain for all channels with a drainage area of more than fifty (50) acres within the project shall be shown on the Improvement Plan.

12. 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 Transportation Cabinet, Bureau 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 = 2.0.

13. Headwalls – Standard headwalls for pipe sizes twelve (12) thru twenty-four (24) inches and headwalls including wingwalls and aprons for pipes larger than twenty-four (24) inches, shall be constructed at the outfall of all storm sewers in accord with "Standard Construction Drawings" as shown in Appendix "C" of these regulations. No grate shall be placed on any headwall.

    Safety guards and railings shall be provided along the top and slope/winged sidewalls on all headwalls inlet and outlet structures having a vertical drop of four feet (4.0') or greater. Such guards and railings shall be at least 42-inches in height measured vertically above the wall. Guards or railings shall not have an ornamental pattern that would provide a ladder effect. Vinyl coated chain link fencing is an acceptable guard type.

14. Other Drainage Improvement Measures – Other drainage improvements measures may be required to provide the necessary hydraulic characteristics required for adequate drainage. These other measures include stream bed cleaning, removal of obstructions, stabilization of banks or areas to eliminate erosion, widening, deepening or realignment of streams, construction of ponds behind dams or other measures for adequate drainage.

15. Sub-surface Springs – While constructing developments, sub-surface springs may be disturbed. In these cases, it is the responsibility of the developer to adequately

address the removal of the water from the surface. This would include installing a pipe network to transfer water to a storm water structure or natural stream. Discharge of this type of water shall not be onto the lot directed toward the street, or on any part of the lot that will pond water. It is the responsibility of the developer to correct any problem with sub-surface springs up to three (3) years after recording of the Final Plat.

16. All ditch backfill in material shall meet the requirements of Appendix "A", Item 1.4.

17. Specifications for Construction and Materials – See Appendix "C" and Appendix "D".

D. Basic Design Criteria for Storm Water Drainage channels, Water Courses and Erosion Control

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 (T_C) helping to maintain the runoff rate nearer to that which existed prior to development. The objective of open channel flow design is to: a) determine a channel slope and size that will have sufficient capacity to prevent undue flooding damage during the anticipated peak runoff period; b) 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.

1. Degree of Protection – Storm water drainage channels and water courses shall be adequate to handle runoff from storms of the frequencies of occurrence shown for the degrees of site development as follows:

   a. For all subdivisions and developments twenty-five year (25 yr.) frequency

   b. For main flood control channels – one hundred year (100 yr.) frequency. The runoff computed from these storms shall be that from the area within the subdivision and from all other areas considered as fully developed in accord with development planned in the Grant County Comprehensive Plan.

   c. Determination of Quantity of Runoff – 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.
   d. Drainage Channel – Capacities – Drainage channels shall be designed to carry flows as determined by methods previously described. Channel cross-sections areas shall be determined by Manning's formula, using a vale of "n" from the following chart.

Drainage Channel Manning's "n" Values

Concrete	0.013
Earth (non-vegetation)	0.022
Rip-Rap	0.035

Rock Cuts	0.035
Grass-mowed short	0.050
Grass-tall stand	0.100
Natural Channels	
Clean and Straight	0.030
Stone and some Weeds*	0.035
Gravel and Rock	0.040
Weedy and Winding	0.060
Dense Weeds and Brush	0.100

*This is typical for a natural intermittent stream

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.

2. Erosion Control for Drainage Channels – 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:

   a. Sown grass covers, seeded degradable turf reinforcing mats
   b. Sod
   c. Permanent turf reinforcing mats
   d, Aggregate channel lining (minimum KDOT Type II channel lining, underlain with fabric;
   e. Aggregate filled gabion baskets or mattresses (underlain with filter fabric;
   f. Interlocking concrete blocks or cabled mattress (underlain with filter fabric);
   g. Reinforced concrete or precast paving (of at least 4" thickness)
   h. Energy dissipaters.

   Any placement of erosion control materials in a channel may require a permit from the Kentucky Division of Water and the US Army Corp of Engineers.

   Alternate methods of channel erosion control will be considered on an individual case basis. Note that the methods above are generally listed in order of increasing erosion protection ability. The design requirements below indicate the minimum level of protection. Any method listed above with higher erosion protection ability than the minimum listed below will be acceptable.

3. Design Velocities:

   a. Minimum Design Velocities:
      Design velocities should generally be greater than 1.5 fps to avoid excessive deposition of sediment. When flattened slopes are unavoidable, method "g" shall be used to accelerate runoff.

   b. Design velocity between one and one-half (1.5) and five (5) feet per second:

Method “a” shall be used. 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, or three (3) feet beyond the top of the channel bank. Seeding shall be a perennial or annual mixture of grass seeds applied at a rate of 75 pounds per acre. Acceptable whole fertilizer shall be applied at a rate of 75 pounds per one thousand square feet. Where seeding is required and the soil is not capable of supporting vegetation (such as sandy soils or clay types), appropriate action shall be taken to bring the soil to an acceptable condition which will support the growth of seed. A degradable turf reinforcing mat is recommended to help stabilize the soil until the grass has become fully established.

c. Design velocities between five (5) and nine (9) feet per second:
Methods “b” and “c” shall be used. The bottom and sides of the earth channel shall be sodded and pegged to remain in place or a permanent turf reinforcing mat shall be installed and seeded. Where seeding or sodding is required and the soil is not capable of supporting vegetation (such as sandy soil or clay types), appropriate action shall be taken to bring the soil to an acceptable condition which will support the growth of seed or sod.

d. Design Velocities between nine (9) and fourteen (14) feet per second:
Methods “c” and “d” shall be used.

e. Design velocities between fourteen (14) and twenty (20) feet per seconds:
Method “d’ and “e’ shall be used.

f. Design velocities greater than twenty (20) feet per second:
Method “e” shall be used.

A method greater than the required minimum, may also be necessary at bends, changed in alignment, junctions with other ditches and at other locations where erosion is more likely to occur. Design velocity at the downstream end of a protected channel shall be equal to or less than the natural velocity in the receiving channel. Energy dissipation may be necessary to reduce the velocity prior to reintroduction into a receiving channel.

4. Buffer Zones – To help protect natural channels and streams within a development, there shall be buffer zones placed over these areas. These buffer zones shall coincide with the buffer zones as defined in the Kentucky Division of Water Permit KYR10. A copy of the application for this permit with the SWPPP shall be submitted with the Improvement Plan Application. Upon approval of the application, a copy shall be submitted to the Planning Commission’s Engineer. The location of these zones shall be shown on the Improvement Plan. The location of the zones shall be field staked prior to any clearing or grading in the vicinity of the zones.

5. Drainage Channel or Water Course Relocation - In order to minimize hillside slippage near relocated drainage channels or water courses due to drainage channel depth or character of the earth in the drainage channel fill and side slopes, precautions shall be taken to compact the fill and side slopes, provisions of under drainage, bank

protection or reinforcing or other measures. Additional easements width shall be provided at such possible slide areas.

6. Erosion Control - All subdivision developments shall have a Best Management Practices (BMP) document prepared and submitted with the Improvement Plan. This document shall meet the minimum requirements as stated in the current "Kentucky Best Management Practices for Construction Activities" prepared by the Kentucky Division of Water (KDOW). A copy shall be on site at all times. Permit application with the KDOW and US Army Corps of Engineers shall be submitted with the Improvement Plan. All graded areas are to be maintained at all times to prevent erosion and excessive runoff. Drainage swales, silt checks, temporary sedimentation basins, etc., are to be used and maintained during the grading operation. All collected sedimentation shall be removed from the detention site. All slopes and graded areas are to be seeded after the grading of that area has been completed.

Additional erosion control measures to prevent erosion and excessive runoff may be required.

7. Mud and Debris - Until all lots and street improvements in the subdivision have been completed, the subdivider shall take such measures, as are necessary, to prevent erosion of graded surfaces and to prevent the deposit of soil and debris from graded surfaces onto public streets, into drainage channels, storm sewers or onto adjacent land.

8. Specifications for Construction and Materials - In all other respects, the design, materials and construction shall be as specified in Sections 206, 212, 601, 610, 703, 710 of the current State of Kentucky "Standard Specifications for Road and Bridge Construction".

9. Equipment on Streets – Operation of any equipment on existing pavements shall per local ordinance.

E. Basic Design Criteria for Stormwater Runoff Control Facilities

In order to minimize damage to downstream properties sediment pollution of public and private waters and hydraulic overloading of existing drainage facilities, the storm water runoff from a subdivision after development shall not exceed the pre-development discharge from that subdivision calculated by using a undeveloped runoff coefficient c = 0.40. Detention shall be provided for all subdivisions and developments. The detention facility may be designed for each individual lot in commercial or industrial zones, but regional basins are encouraged to be provided throughout the subdivision or development. All basins within residential zones must be regional. Such facilities shall be designed so that no standing water will remain in detention basins during dry weather or the design of retention ponds that will allow standing water to stagnate and present health hazards. In certain cases, other non-basin detention/retention techniques such as underground vault storage and ponding water on parking lots may be utilized when approved by the Planning

Commission. Individual site storm water management shall be reviewed under the applicable zoning regulations. The amount of water to be detained shall be determined by the methods described in the following paragraphs:

1. Storm Water Control Facility Volume Calculations – Estimated runoff shall be calculated by an accepted method that generates an inflow/outflow hydrograph such as Soil Conservation Service (SCS) method or the Modified Rational Method (MRM). All calculations shall be generated through a computer program. All documents shall be submitted for review by the Planning Commission's Engineer.

2. Pre-Development Calculations – Calculate the subdivision or development site runoff based on a 2, 10 and 50 year storm frequency curve. The entire acreage contributing to the runoff shall be included in the calculations.

3. Post-Development Calculations – Calculate the proposed ultimate development runoff based on a 2, 10 and 50 year storm frequency curve. The entire acreage contributing to the runoff shall be included in the calculations.

4. Storage Requirement – The amount of detention/retention storage required for a subdivision or development shall be the amount determined from the inflow/outflow hydrograph as previously outlined based on the fifty year (50 yr.) storm frequency. If the Modified Rational Method is used, the storm duration used shall be the one that produces the maximum storage.

5. Discharge from Detention/Retention Basin – The discharge from the detention/retention basin shall be controlled by a multi-stage release outlet structure and not be greater than a pre-development rate based on a 2, 10 and 50 year storm frequency at that particular point where the discharge occurs. Alternate methods using water quality volume design may be used upon approval by the Planning Commission's Engineer. The routing of an emergency spillway shall be shown based on the one hundred year (100 yr.) storm frequency. Trash racks shall be required to be installed on the outlet structure in the detention/retention basin to prevent clogging.

F. Detention/Retention Basins – Standards and Specifications

1. Definition and Scope – 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:

   a. Failure of the structure will not result in loss of life, damage to homes or interruption of use or service of public utilities

   b. Drainage area does not exceed two hundred (200) acres.

   c. The water surface at the crest of the emergency spillway does not exceed five 95) acres.

d. All detention basins shall be designed and built with side-slopes no greater than 3:1 (three feet horizontal per one foot vertical) and proper outlet structures to insure do standing water during dry periods.

e. All retention basins shall have dams 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 public dedicated street right-of-way, the developer shall have a geotechnical report prepared with recommendations on the design and construction of the dam.

G. Residential Lot Grading and Drainage

1. Lot Grading – Within the limits of the public right-of-way adjacent to street pavements, all final grading for grass strip, sidewalk and yards to the building structure, shall comply with minimum and maximum grades in accord with the typical sections for streets, as shown in Appendix "C".

2. Swales – 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 on into a storm inlet or natural drainage area. Swales for handling lot drainage shall be constructed as a part of the final lot grading and be seeded and mulched or sodded as soon as possible to prevent erosion.

3 Roof and Subsurface Drains – Roof downspout, footing or foundation drains shall be discharged onto the same parcel of land from which the water is generated. Roof downspouts shall terminate onto a splash block. All subsurface drains, including sump pumps, shall be constructed toward the rear of the lot. No roof or subsurface drain shall outlet nearer than two feet (2') to a property line and twenty feet (20') to any right-of-way line. If a collection system was approved, then sump pump drains may be connected to the system.

H. Maintenance of Retention/Detention Areas

In all commercial and industrial subdivisions or developments, the owner of each lot shall be responsible for properly maintaining each retention/detention area in order for such facility to function according to its design and purpose.

In all residential subdivisions or developments, only appropriate storm sewer easements around inlet/outlet structures and related storm sewer piping and a storm water retention/detention easement over the area of the one hundred year (100 yr.) storm event shall be dedicated to the appropriate legislative body. The legislative body shall be responsible for maintaining only those facilities (inlet/outlet structures and storm sewer piping) located within the dedicated storm sewer easements. The area of the retention/detention basin shall be owned and maintained by the adjoining property owners

or Home Owners Association. The maintenance responsibility of the owners of the retention/detention basin shall be included in the Subdivision Restrictive Covenants.

SECTION 8.2 SOIL EROSION and SLOPE CONTROL:

The developer of a proposed subdivision or development shall require submit to the Planning Commission a detailed plan for erosion and/or sedimentation control. The plan shall contain proposed methods for slope stabilization, erosion control and water pollution abatement and shall be reviewed by the Planning Commission. The Planning Commission shall require that such plan or part thereof be submitted with the Improvement Plan and Grading Plan.

A. Prior Grading or Disturbed Site: No Improvement Plan and/or Grading Plan may be approved where the site has been graded, stripped, excavated, de-vegetated or otherwise disturbed so that slipping; erosion and/or water pollution has or may reasonably be expected to occur until conditions are corrected to the satisfaction of the Planning Commission.

B. Soil Survey: The current "Soil Survey of Grant and Pendleton Counties, Kentucky issued by the United Sates Department of Agriculture, Soil Conservation Service in cooperation with the Kentucky Agriculture Station is hereby made a part of these regulations and will be used for informational; and reference purposes.

C. Erosion Control Measures: All proposed erosion and slope control measures must be per the current "Kentucky Best Management Practices for Construction Activities".

SECTION 8.3 SANITARY SEWER SYSTEM:

Connection into either an existing or planned public sanitary sewer system shall be required if the system is sufficient or can be expanded in order to accommodate the additional flow from the proposed subdivision.

A. DESIGN STANDARDS: All sanitary sewer improvements shall meet all design specifications as adopted by the appropriate legislative body or the Grant County Sanitary Sewer District where appropriate.

B. BACKFILL AND COMPACTION WITHIN IN THE PUBLIC RIGHT-OF-WAY**:** All trenches within a Public Right-of-Way shall be backfilled as specified in Appendix "A", Section 1.4. Copies of all testing reports shall be submitted to the Planning Commission's Engineer.

C. PACKAGE SEWAGE TREATMENT PLANTS: Where package sewage treatment plants are proposed, the sewage collection system shall be designed for ultimate connection to the public system. The package sewage treatment plant shall be designed and constructed in accordance with the current standards and specifications of the State of Kentucky and the appropriate legislative body or the Grant County Sanitary Sewer District where appropriate. The developer shall provide a dedicated sanitary sewer easement from the package treatment plant to the developer's property line located at the low point within the subdivision or development and an adequate access easement in order to provide truck and equipment access to the proposed package sewage treatment plant to the nearest

public right of way. The location of this sanitary sewer easement shall be designed so as to permit the future connection into a regional sewer system. The location of this easement shall be approved by the Planning Commission's Engineer and the Grant County Sanitary Sewer District where appropriate and shall be shown on the Preliminary Plat. This sanitary sewer easement shall be recorded, by the developer, at the Grant County Court Clerk's office before the treatment plant is placed in operation. No sanitary sewage treatment plant for any subdivision shall be located nearer than two hundred feet (200') to any residence. In calculating this distance, the applicant can specify the location of any residence to be constructed on lots affected by the treatment plant or the Planning Commission shall calculate this distance based upon the minimum setback and yard requirements of that particular zone.

D. INDIVIDUAL SEPTIC TANK SYSTEMS: Where individual septic tank systems are proposed, the septic tank system must meet the specifications of and receive a permit from the Northern Kentucky District Health Department. The developer shall provide dedicated sanitary sewer easements from all lots within the subdivision to the developer's property line located at the low point within the subdivision or development. The location of these sanitary sewer easements shall be located so as to permit the future connection into a regional sewer system. The location of this easement shall be approved by the Planning Commission's Engineer and the Grant County Sanitary Sewer District where appropriate and shall be shown on the Preliminary Plat and recorded on the Final Plat.

SECTION 8.4 WATER SYSTEM:

Connection into either an existing or planned public water system shall be required if the system is sufficient or can be expanded in order to accommodate the additional flow for the proposed subdivision.

A. DESIGN STANDARDS: The specifications adopted by the appropriate legislative body or water district. Where appropriate, water mains shall be designed to loop back to existing or proposed water mains.

B. FIRE HYDRANTS: Fire hydrants shall be provided in all subdivisions where public water systems are provided. Fire hydrants shall have a maximum spacing of 500 feet, as measured along the street right-of-way line. Fire hydrants should be located no further than 250 feet from any building site. In calculating this distance, the applicant can specify the location of any residence to be constructed on lots affected or the Planning Commission shall calculate this distance based upon the minimum setback and side yard requirements of that particular zone. Additional hydrants are not required to serve a flag lot if a hydrant is located within 150 feet of the vehicular entrance to the flag lot. Where existing public water mains that have existing fire hydrants are to serve a proposed subdivision and no public water main construction is necessary, no additional fire hydrants are required.

C. BACKFILL UNDER STREET PAVEMENT**:** All trenches located under any street pavement shall be backfilled with controlled-low-strength-material (CLSM) (Flowable Fill).

D. INDIVIDUAL ON-SITE WATER SUPPLY: Where individual on-site water supply systems (wells and cisterns) are proposed, the on-site water supply system must meet the

specifications of the Northern Kentucky District Health Department and the State of Kentucky.

SECTION 8.5 STREETS:

All public maintained streets shall be designed and constructed to the following minimum requirement.

A. PAVEMENT SPECIFICATIONS: All streets shall be paved in accordance with the specifications in Appendix "A" or "B" of these regulations.

B. MINIMUM PAVEMENT WIDTHS: No public street shall be constructed except in conformance with the minimum pavement widths as follows:

Arterial Streets	36 feet
Collector Streets	30 feet
Sub-Collector	28 feet
Local Street	25 feet
Cul-de-sac	25 feet
Alley	20 feet

C. CURB AND GUTTER: All curb and gutter shall be constructed of cement concrete as set forth in Appendix “A” and according to the typical section detail in Appendix "C".

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

TYPE OF STREET* INTERSECTION	MINIMUM CURB RADIUS
Alley – Local	25 feet
Local-Local or Subcollector	25 feet
Subcollector-Subcollector	25 feet
Subcollector-Collector	30 feet
Collector-Collector or Arterial	45 feet
Arterial-Arterial	**

∗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.

E. Horizontal Curves: Central angles of horizontal curves shall be kept to a minimum unless there is sufficient radius length to minimize the severity of the curves. At no time shall the radius of the centerline of a proposed street be less than two feet (200) for collector and sub-collector streets, and one hundred feet (100) for local streets.

The tangent distance between horizontal curves of proposed street centerlines shall not be less than one hundred feet (100) for any arterial or collector street.

F. PAVEMENT GRADES - Grades on both public and privates streets in proposed subdivisions or developments shall be as follows:

1. The minimum grade on all streets shall be one and one-half percent (1.50%).

2. The maximum grades permitted on streets are:

Arterial Street	7.0 percent
Collector Street	10.0 percent
Sub-collector Street	10.0 percent
Local Street	12.0 percent
Cul-de-sac Street	12.0 percent
Alley	12.0 percent

3. Centerline grades within an intersection on a collector street or a sub-collector street, the maximum grade on the centerline of the intersecting side street shall not exceed four percent (4%) for a distance of not less than seventy five feet (75'), as measured from the intersection point.

4. These maximum grades may be modified by the Planning Commission where extreme topographic conditions exist.

G. VERTICAL CURVES: The minimum vertical curve length required shall be calculated by multiplying the algebraic difference in grades by a "K" factor, as follows:

Arterial Street	Design Standards of the Kentucky Department of Transportation
Collector Streets	K = 30 for crests curves K = 35 for sag curves
Sub-collector Street	K = 15
Local Street	K = 15
Cul-de-sac Street	k = 15
Alley	K = 15

H. TEMPORARYDEAD-END STREETS: When any street is temporarily dead-ended a temporary turn-around shall be provided.

I. CONSTRUCTION OF REQUIRED PAVEMENT WIDTH ON EXISTING STREETS: When a subdivision is located on an existing street, except for arterial streets, and where the pavement width of such existing street is less than that required by these regulations, the subdivider shall 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. If the required widening is less than two (2) feet then it shall not be required.

When pavement widen is required under the section, the required pavement width shall be 22 feet when no lots front on the street requiring widening. When the subdivision has lots fronting on the street requiring widening, the pavement width shall be as in Section 7.4 - B of these regulations.

SECTION 8.6 DRIVEWAY APPROACHES:

All driveways within a public right-of-way shall be constructed in accordance with standard construction details within Appendix "C"

SECTION 8.7 OFF-STREET PARKING AREAS:

Off-street parking areas shall be constructed in accordance with the requirements of the applicable zoning ordinance.

SECTION 8.8 UTILITY LINES:

All utility lines shall be installed underground and be in conformance with the appropriate utility company's policy and requirements.

SECTION 8.9 CONSTRUCTION INSPECTIONS:

Inspections relative to the construction and installation of public improvements such as sanitary sewers, water mains, driveway aprons and sidewalks shall be made by the appropriate sewer district, water district or legislative body. The inspection of storm sewers, street paving, and site grading, including soil erosion shall be made by the Planning Commission’s Engineer. Inspectors are authorized to inspect all work done and all materials furnished. Such inspections, 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. The inspector shall not be authorized to revoke, alter or waive any requirement of the approved Improvement Plan drawings and specifications. Any changes in the approved improvement plan and specification shall be approved by the Planning Commission.

The contractor shall notify the appropriate inspector(s) a minimum of 24 hours prior to the time when the work is to begin on each phase of construction, such as embankments, subgrade, water systems, storm and sanitary sewer systems, street paving, sidewalks, including all relative testing. The inspector shall begin inspections at the time of construction and maintain inspection as the

work proceeds on each phase of the project until all construction is complete. During the time of construction, any work determined by the inspector not to conform to the requirements of the approved improvement plans, drawings and specifications shall be suspended and corrected, prior to proceeding with that phase of the project.

Any work which cannot be determined to conform to the approved plans, drawing and specifications shall be referred to the design engineer for revision and/or modification and decided upon by the Planning Commission.

SECTION 8.10 SUBDIVIDERS and/or CONTRACTORS CONSTRUCTION RESPONSIBILITIES:

The subdivider and/or contractor shall have available on the project, at all times, a copy of all approved plans and specifications. The subdivider and/or contractor superintendent shall be capable of reading and thoroughly understanding the plans and specification and he or she shall receive instructions from the inspector. A superintendent shall always be present regardless of the amount of work sublet.

SECTION 8.11 FINAL CLEANING UP:

Upon completion of construction work of the subdivision or on an individual lot, the subdivider, developer and/or contractor shall remove all debris and/or excess fill in connection with the completed work prior to final plat approval.

SECTION 8.12 WRITTEN AGREEMENTS AND GUARANTEES:

A subdivision developer or subdivider may execute and file a written agreement or guarantee with the Planning Commission in lieu of actual installation or completion of the required public improvements when requesting approval of the final plat. Such agreements or guarantees shall be in an amount required to complete the public improvements, as estimated by the subdivider's engineer and approved by the Planning Commission. The cost estimate shall have supporting written data and be based on the amount determined to be reasonably necessary to complete all of the public improvements required to be constructed by the subdivider as specified in the approved improvement plans, drawings and specifications, including a twenty (20%) percent contingency.

Such agreements or guarantees can only be used when a substantial amount of the public improvements (e.g. grading and construction work related to sanitary sewers, storm sewers, water mains and streets) of the subject phase or section of the improvement plan are installed and inspected. Specifically, a minimum of seventy-five percent (75%) of all public improvements (e.g. grading and construction work related to sanitary sewers, storm sewers, water mains and streets) and a minimum of seventy-five percent (75%) of public street pavement (measured in lineal feet) shall be installed before an agreement or guarantee for the remaining public improvements can be used and approved by the Planning Commission. The seventy-five percent (75%) of all public improvements is based upon the dollar amount of improvements installed per section or phase divided by the total cost of the improvements of the proposed platted section of the subdivision. The seventy-five percent (75%) figure shall be certified by the subdivider's design engineer with appropriate documentation.

The written agreement or guarantee shall typically be in the form of sureties (e.g. bond payment or performance bond from an insurance company or a financial institution), a cash deposit (e.g. escrow agreement or certified check from a financial institution), or an instrument of agreement from one or more financial institutions (e.g. irrevocable letter of credit) and payable to the Planning Commission. The agreement or guarantee shall be pursued by the subdivider and developer by an insurance company or financial institution. The agreement or guarantee shall be an assurance of faithful performance of any and all work and the construction and installation of all public improvements required to be done by the subdivider, as specified in the approved Improvement Plan, drawings and specifications. Any irrevocable letter of credit shall be in the format provided by the Planning Commission.

The agreement or guarantee shall have no expiration date but all work must be completed within one (1) years of the approval of the Final Plat unless approved by the Planning Commission, and shall contain the condition that should the subdivider fail to complete all construction work and public improvements required, the Planning Commission may elect to complete all required public improvements and construction work on its own. Consequently, the Planning Commission shall be authorized, in the event of any default on the part of the subdivider of the performance of any work or construction of any public improvements for which such guarantees been agreed to, to complete the required work to be done and to withdraw that amount required for payment of all cost.