Stormwater Procedures Manual

December 2017

City of Frankfort & Franklin County, Kentucky

Prepared by:

TETRA TECH

Table of Contents

Chapter 1 Use of this Manual

1.0 Preface

This Manual represents a coordinated effort to bring water resource managers, developers and designers up-to-date with the regulations and criteria applicable to stormwater management design and program management. The City of Frankfort and Franklin County evaluates its stormwater management program annually to provide efficient and economical implementation of stormwater management systems within the jurisdiction. The City/County have developed this procedures manual which currently contains Stormwater Design Standardsand Illicit Discharge Detection and Elimination Procedures.

This "Stormwater Procedures Manual" (Manual) is been adopted by reference in a number of City/County Ordinances. Stormwater management design, construction and maintenance shall comply with the requirements of this Manual and applicable Ordinances. The Manual contains all current information and standards or criteria for designing and submitting construction plans for all proposed stormwater management facilities to be constructed in the City of Frankfort and Franklin County. Illicit Discharge elimination shall comply with the requirements of Chapter 3 of this manual and the Illicit Discharge Detection and Elimination Ordinance.

1.1 Purpose

The purpose of this Manual is to guide businesses, industry and the general public in the policies and procedures of the City/County stormwater program. This includes guidance to engineers, architects, planners and developers in the design of stormwater management systems in the City/County. The Manual integrates recommended methodologies and design procedures, as well as the City/County's required stormwater management design standards and criteria into a single-source document. The Manual is compatible with the requirements of the City/County Capital Improvement Program and the Stormwater Quality Management Plan (SWQMP) of the City/County's KPDES permit.

Chapter 2 Stormwater Design Standards

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Table of Contents

Table of Contents (continued)

1.0 Introduction

1.1 Background

The City of Frankfort and Franklin County, Kentucky, (referred to as City/County) acting in cooperation, have established new design criteria for the design and implementation of stormwater facilities in new development or redevelopment. The purpose of these standards is to provide a common set of guidelines that will produce consistency in design for stormwater facilities constructed either publicly or privately. This is necessary because in many cases the City/County becomes ultimately responsible for maintenance and operation of stormwater infrastructure that was originally intended for private ownership. This document is intended to be revised in the future as the need for new regulations arises and as the City/County continues to progress. The current version includes new sections pertaining to Water Quality Regulations and Geographic Information Systems (GIS).

These standards serve as a guideline for routine development. The City/County may at any time require additional analysis or may deviate from these guidelines in special circumstances. This applies especially to development adjacent to rivers, streams, and sinkholes, or development in or immediately upstream of known problem areas. Additionally, the City/County may initiate a "fee in lieu of" program where it will be advantageous to share the cost of constructing regional stormwater infrastructure.

These standards also develop a standard procedure for submittal of engineering plans and calculations for review by the City/County and will establish a methodology aimed at assuring uniform quality of design and construction. This chapter does not directly address water quality issues or the City/County's Phase II Stormwater plan, however the stormwater criteria in this document is intended to be congruent with water quality Best Management Practices (BMPs).

1.2 List of Abbreviations

CN	Curve Number
COE	U.S. Army Corps of Engineers
BMP	Best Management Practice
FEMA	Federal Emergency Management Agency
GIS	Geographic Information Systems
HEC	Hydraulic Engineering Center
HGL	Hydraulic Grade Line
KDOW	Kentucky Division of Water
KPDES	Kentucky Pollutant Discharge Elimination System
KTC	Kentucky Transportation Cabinet
LOMR	Letter of Map Revision
NRCS	Natural Resource Conservation Service
SCS	Soil Conservation Service
Tc	Time of Concentration
T_{Lag}	Lag Time
TR-55	Technical Release 55
UIC	Underground Injection Control
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

2.0 Definitions

For the purposes of this chapter, the following terms, phrases, words, and their derivatives shall have the definitions stated below.

APPROVING AGENCY. The City of Frankfort Public Works Director or County Planning and Building Codes Director and their duly authorized designees, responsible for review and approval of stormwater management plans.

BEST MANAGEMENT PRACTICES (BMP). A technique or series of techniques, structural or nonstructural, which are proven to be effective in controlling runoff, erosion, sedimentation and mitigate flooding.

DETENTION FACILITY. A temporary or permanent natural or manmade structure that provides for the temporary storage of stormwater runoff which is designed so as not to create a permanent pool of water.

DEVELOPER. Any person, firm, corporation, sole proprietorship, partnership, state agency, or political subdivision thereof engaged in the development or redevelopment of property.

DRAINAGE AREA. That area contributing runoff to a single point measured in a horizontal plane, which is enclosed by a ridge line.

EXTENDED DETENTION. A stormwater design feature that provides gradual release of a volume of water in order to increase settling of pollutants and protect downstream channels from frequent storm events.

FLOW ATTENUATION. Prolonging the flow time of runoff to reduce the peak discharge.

INFILTRATION. The passage or movement of water into the soil surface.

LAND DISTURBANCE ACTIVITY. Any land change that may result in soil erosion from wind, water and/or ice and the movement of sediments into or upon waters, lands, or rights-of-way within the City/County, including but not limited to building demolition, clearing and grubbing, grading, excavating, transporting and filling of land.

PRINCIPAL CONTROL OPENINGS. All openings within a control structure excluding the emergency spillway.

PUBLIC WORKS DIRECTOR. The City of Frankfort Public Works Department Director and City Engineer.

REDEVELOPMENT. Any construction, alteration, or improvement involving land disturbance performed on sites where existing land use is commercial, industrial, institutional, or multifamily residential.

RETENTION FACILITY. A temporary or permanent natural or manmade structure that provides for the storage of storm water runoff by means of a permanent pool of water.

RETROFITTING. The construction of a structural BMP in a previously developed area, the modification of an existing structural BMP, or the implementation of a nonstructural practice to improve water quality over current conditions.

RUNOFF. Rainfall, snowmelt, or irrigation water flowing over the ground surface.

SEDIMENT. Soils or other surficial materials transported or deposited by the action of wind, water, ice, or gravity as a product of erosion.

SITE PLAN. A plan or set of plans showing the details of any land disturbance activity of a site including but not limited to the construction of structures, open and enclosed drainage facilities, stormwater management facilities, parking lots, driveways, curbs, pavements, sidewalks, bike paths, recreational facilities, ground covers, plantings, and landscaping.

STORMWATER DESIGN STANDARDS. The City/County Stormwater Procedures Manual, latest version that serves as the official guide for stormwater design principle, methods and practices.

STORMWATER MANAGEMENT. For:

(1) Quantitative control, a system of vegetative and structural measures that control the increased volume and rate of surface runoff caused by man-made changes to the land, and

(2) Qualitative control, a system of vegetative, structural, and other measures that reduce or eliminate pollutants that might otherwise be carried by surface runoff.

WATERCOURSE. Any natural or improved stream, river, creek, ditch, channel, canal, conduit, gutter, culvert, drain, gully, swale, or wash in which waters flow either continuously or intermittently.

WATERSHED. The total drainage area contributing runoff to a single point.

WETLANDS. A lowland area such as a marsh, that is saturated with moisture, as defined in Sec. 404, Federal Water Pollution Control Act Amendments of 1987.

3.0 Design of Stormwater Appurtenances

3.1 Design Storm

The following hypothetical design storms will be utilized for stormwater infrastructure design applications as shown in Table 3.1-1. Time vs. depth tabulations of each design storm are provided in Appendix A.

Table 3.1-1 Design Storm Applications

Design Storm	Stormwater Facility					
	Floodplains	Detention Ponds	Inlets	Storm Sewers	Culverts & Bridges	Constructed Channels
10 year- 1 hour		•	•	•		
100 year – 6 hour		•		•		•
100 year – 24 hour	•	•			•	

The Rational Method may be used to generate peak flow for sizing inlets, storm pipes, culverts, and channels where the drainage area is less than or equal to 10-acres. Rational Method "C" factors shall be weighted in proportion to the percentage of impervious cover ranging from 0.20 for zero impervious cover to 0.95 for 100% impervious cover.

Rainfall Intensities for use in the rational method are provided in Table 3.1-2. See sample calculations (Appendix E) for an example of the rational method.

Table 3.1-2 Design Storm Rainfall Intensity

Time of Concentration* (minutes)	Intensity (inches/hour)						
	1-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
6	4.32	5.12	6.01	6.73	7.65	8.34	9.03
10	3.52	4.18	4.91	5.47	6.16	6.67	7.18
15	2.88	3.42	4.02	4.49	5.08	5.52	5.94
30	1.92	2.29	2.77	3.13	3.6	3.96	4.32
60	1.17	1.41	1.74	2	2.34	2.62	2.9

Source: NOAA Atlas 14 Volume 2 Version 3

* See Section 4.2 for calculation of Time of Concentration. The minimum Time of Concentration will be 6 minutes (0.1 hours).

3.2 Inlets

Either curb inlets or combination inlets may be utilized for street drainage. Grated inlets may be permitted only where topographic conditions warrant. Inlets shall be placed at the following locations to prevent the flow of concentrated water across traffic lanes:

- Sags in roadway
- Upstream of intersections
- Upstream of transitions from normal crown to super-elevated roadway

Storm sewer systems located in the right-of-way or within drainage easements may be installed as box or roll type curb and gutter and are to include access for maintenance and inspection.

3.2.1 Inlets on Grade

Inlets on grade shall be spaced at intervals as required to limit the spread of gutter flow into the traffic lane using an intensity of 4 in/hr for spread as follows:

- 6-feet into driving lane where design speed is less than or equal to 45 mph
- 4-feet into driving lane where design speed greater than 45 mph
- The inlet shall be designed assuming flow only through the curb opening if a grate is present
- An overflow channel shall be provided that assumes that inlets in low points are 50% obstructed; this channel shall be designed with easement to carry the portion of the 100-year storm that does not enter the inlets
- Maximum distance between curb inlets of 600 feet

The use of software such as HEC 22 (Kentucky Transportation Cabinet) should be used to calculate interception capacity and spread of water when spacing inlets on grade.

3.2.2 Inlets in a Sag

Inlet design curves (see Appendix B) should be used to determine interception capacity of street inlets and surface (yard) inlets located in a sag condition.

3.3 Storm Sewers

Storm Sewers shall be sized to flow under gravity conditions for the 10-year 1-hour design storm and shall be able convey the 100-year 6-hour storm without overflows. In general, storm sewers will be appropriate for 100-year peak flow rates less than 100 cfs. Constructed channels should be utilized for larger flows. The following elements will be incorporated in storm sewer design:

- Minimum pipe slope of 0.5 %
- Minimum full velocity of 3 fps for the 10-year storm
- Size pipes so that the hydraulic grade line is at least 12 inches below the overflow elevation at inlets and manholes for the 100-year storm
- Maximum manhole spacing of 300 feet

- Provide a minimum cover of 18 inches
- Inaccessible junctions shall not be utilized
- Pipe material shall be concrete or HDPE unless pipe diameter is greater than 36" in which case it may be aluminized corrugated metal
- Minimum pipe size for proposed lines is 12 inches

Storm sewers should be designed using software capable of generating a profile of the HGL for a given peak design flow. Storm sewer shall be designed to match crown to crown where possible.

3.4 Constructed Channels

Constructed channels are typically utilized to provide drainage in low density developments of at least 1 acre, or to convey flows too large for underground storm sewers (-100 cfs). If a constructed waterway is in regulatory waters (see Section 5.0) a 401/404 permit (see Section 6.1) will be required. Constructed channels shall be designed using the Manning Equation (Appendix E) according to the following criteria:

- Channel depth shall be as necessary to convey 100-year 6-hour (see Table 3.1-1) peak discharge
- Utilize side slopes no steeper than 2-H:1-V for channels with a rock or rigid lining and 3-H:1-V for grass or vegetative lined channels.
- Channel bottom shall have a 12H:1V cross slope if bottom width> 10 feet.
- Channel freeboard shall be the larger of 1-foot or two velocity heads
- Utilize a channel lining which is stable during a 100-year discharge (Section 3.4.1)
- Drainage easement width shall be the larger 20 feet or twice the channel topwidth
- Utilize concrete trickle channels to prevent standing water in residential areas

Constructed channels shall be sized using the Manning's N values listed in Table 3.4-1.

Table 3.4-1 Manning's N Values

Lining Type	Manning's N
Concrete	0.013
Grouted Stone	0.030
Stone Masonry	0.032
Bare Soil	0.020
Rock Cut	0.035
Jute Net	0.022
Straw with Net	0.033
Curled Wood Mat	0.035
6-inch D_{50} Riprap	0.050
12-inch D_{50} Riprap	0.060
Grass	0.045
Natural Streams	0.045
Floodplains	
Pasture, no brush	0.035
Brush	0.10
Trees	0.12

3.4.1 Erosion Protection

Constructed channels shall be lined with a material that is resistant to erosion. After a constructed channel has been designed, a stable channel lining must be selected. The Tractive Force method (Appendix E) shall be utilized to compare the shear stress exerted by the 100-year runoff at normal depth, to the allowable shear stress that a particular channel lining can withstand. Acceptable channel lining materials are presented in order of preference (with allowable shear stress) in Table 3.4-2.

Table 3.4·2 Acceptable Channel Linings

Channel Lining	Allowable Shear (lbs/W)
Grass	1.0
Grass with Turf Reinforcement Mat	1.5-8
Gabion mattress (6-inch rock)	35
Hard Armor (i.e., masonry or tri-loc)	10-25
Concrete	>25

Source: LFUCG Stormwater Manual

Turf Reinforcement Matting shall be used instead of dumped stone or rigid linings where possible. Several different varieties with varying resistance to erosion are available.

3.5 Culverts and Bridges

For the purpose of this document a culvert is defined as a one-barrel or multiple barrel structure with a combined clear span of less than 20 feet. Bridges are defined by span equal to or greater than 20 feet.

3.5.1 Culverts

New construction shall be subject to the following standards: Culverts shall be sized to limit the 100-year 24-hour headwater depth to 2 feet below the top of roadway. Culvert crossings designed for detention (see Section 3.6) must incorporate an emergency spillway conduit below the roadway. Culvert crossings where the top of road is higher than the finished floor of an upstream structure must be designed to pass 150% of the 100-year peak runoff to provide extra protection in case of debris blockage. Culverts will incorporate the following design elements:

- Size so that headwater depth is no greater than 1.2 times the height of conduit during 100-year storm (except in cases of detention)
- Minimum diameter will be 15 inches except for driveways or turnouts
- Conduit shall follow the alignment and slope of the natural channel
- Where upstream drainage area > 1 square mile culverts should preferably incorporate a natural channel bottom
- Concrete headwalls may be required on inlet and outlet except for driveways or turnarounds
- Roadway alignment shall be within 10 degrees of perpendicular to flow
- Culverts shall be concrete, HDPE, aluminized corrugated metal pipe (>0.30”) or other material acceptable to the approving authority

- Culvert outlet protection

Culverts will be designed by calculating the difference in head across the length of the culvert for both inlet and outlet control and designing for the case that produces the highest differential at the design discharge. A software program that follows this methodology should be utilized for this design. Culvert headwalls greater than 30" must have safety railing installed or approved equal.

Replacement of existing structures may deviate from the standards described above at the discretion of the approving authority.

3.5.2 Bridges

Bridges shall be sized so that 100-year 24-hour upstream water depths do not increase more than 1.0 foot above the existing condition unless a drainage easement is provided for the area to be inundated. Bridges will also be sized so that the 100-year water surface is at least 2-feet below the finished floor elevation of existing residential, commercial, or industrial buildings. Bridge decks shall be high enough to pass the 100-year storm with at least 1-foot of clearance between bottom of the bridge and the water surface. An analysis of contraction scour and localized scour at piers and abutments must be performed.

Replacement of existing structures may deviate from the standards described above at the discretion of the approving authority.

Bridges will require a Stream Crossing Construction Permit from the Kentucky Division of Water. HEC-2 or HEC-RAS software, Army Corps of Engineers shall be utilized for backwater and scour analyses.

3.6 Detention Ponds

Detention ponds will generally meet the following criteria. If a proposed detention structure exceeds any of the following criteria, the Dam Safety Section of the Kentucky Division of Water will be consulted to see if additional design guidelines are necessary.

- Drainage area greater than 1-square mile
- Height of impoundment less than 15 feet as measured vertically from top to downstream toe
- Storage volume less than 25 acre-feet
- Nearest roadway, walkway, or building in the downstream floodplain is separated by a distance equal to at least forty times the height of the structure.

Detention ponds will be designed to limit the post development peak runoff to the pre-developed value for the 10-year 1-hour and 100-year 6-hour storms. Additionally, detention ponds shall incorporate an emergency spillway capable of conveying the 100- year 24-hour peak flow rate assuming the principal control openings are fully clogged. Detention ponds will incorporate the following design elements:

- Minimum freeboard of 1-foot above 100-year 6-hour peak stage
- Maximum emptying time of 24 hours
- Safety fencing will be installed when interior embankment slopes exceed 3:1 (City only)
- Multiple smaller orifices may be used however the outflow conduit must not be smaller than 15 inches in diameter
- Provide access (and access easements) for maintenance equipment if maintenance will be performed by City/County
- Ponds that are designed to be normally dry shall incorporate a slope of at least 2% for positive drainage or incorporate a concrete trickle channel.
- Impoundments must be designed by a professional engineer licensed in the Commonwealth of Kentucky
- Detention not in right-of-way

Detention Ponds shall be designed by performing flood routing calculations where inflow and outflow hydrographs are computed. Peak flow rates from the detention pond outflow hydrograph are then compared with the peak flow in the pre-developed condition.

Dual Purpose detention ponds are designed to enhance water quality as well as to control water quantity. Such basins may incorporate a first flush volume with an increased detention time.

These water quality standards are only applicable to properties within the Ms4 permit boundaries.

3.7 Stormwater Quality Treatment Design

Per KDOW requirements the design of post construction BMPs shall attempt to maintain pre-development runoff conditions, including both peak flow and volume. Under post-construction requirements, new and redevelopment projects are also required to include an on-site stormwater runoff quality treatment standard. Design parameters include sizing of post-construction controls that capture and treat eightieth (80th) percentile annual runoff occurring in a typical year from the site.

The Water Quality Volume (WQv) equation, establishes the volume that must be treated from each site. The City/County stormwater quality program requires new and redevelopment projects to treat runoff of 80% of the average annual rainfall, which is considered the “first flush”. Stormwater BMPs must be sized to capture and treat this defined water quality volume which is defined by the City/County as the first 0.87 inches of rainfall from the site. Treatment may be achieved using a single treatment method, or through the use of a treatment train. All stormwater BMPs shall be designed in a manner to minimize the need for maintenance and reduce the chances of failure, while maintaining the required function.

All storms greater than 0.87 inches must be routed non-erosively through the water quality treatment device or routed around it. The Water Quality Volume (WQv) equation, which forms the foundation of the City/County stormwater quality

management program, establishes the volume that must be treated. The following equation shows that this value is equal to the product of precipitation, volumetric runoff coefficient and site area, divided by twelve.

Equation 1 Water Quality Volume Calculation

$$WQv = [P\ Rv)(A)]/12$$

Where,
P is the average rainfall in inches, (0.87 inches);
Rv is the volumetric runoff coefficient, which is:
$Rv = 0.05 + 0.009(I)$, where I is the percent impervious cover; and
A = the total area to be disturbed in square feet

For projects determined by the City/County to be unable to meet the water quality treatment standard or detention requirements, such as those with limited surface area, setbacks, or due to the natural or existing physical characteristics of a site, the following alternatives may be considered at the discretion of the City/County:

- Off-Site Mitigation – The off-site mitigation option entails implementing measures to enhance infiltration/evapotranspiration/reuse that may be implemented at another location in the same sewershed/watershed as the original project. If it can be demonstrated that the proposed development is not likely to impair attainment, provisions may be made to manage stormwater by an off-site facility. The off-site facility is required to be designed and adequately sized to provide a level of stormwater control that is equal to or greater than that which would be afforded by on-site practices. Additionally, there must be a legally obligated entity responsible for long-term operation and maintenance of the stormwater practice proposed.

- Payment-in-lieu – Where the City/County waives all or part of the minimum stormwater management requirements, a monetary contribution may be permitted in-lieu of the stormwater management practices. The payment-in-lieu option allows a site that disturbs at least one acre or a project that is less than one acre but is part of a larger common plan of development or sale to choose to make a payment to the City/County, in lieu of implementing post-construction BMPs. The City/County will apply these in-lieu funds to a public stormwater project. All of the monetary contributions shall be credited to an appropriate capital improvements program project, and shall be made by the developer prior to approval of the Development Plan.

  In lieu of a monetary contribution, an applicant may obtain a waiver of the required stormwater management by entering into an agreement with the City/County for the granting of an easement or the dedication of land by the applicant, to be used for the construction of an off-site stormwater management facility. The agreement shall be entered into by the applicant and the City/County prior to the recording of plats or, if no record plat is required, prior to the issuance of the Development Plan.

3.8 Retention Ponds

Retention facilities include extended detention facilities, infiltration basins, and swales. In addition to stormwater storage, retention may be used for recreation, pollutant removal, aesthetics, irrigation and/or groundwater recharge. Infiltration facilities provide significant water quality benefits, and although groundwater recharge is not a primary goal of stormwater management, the use of infiltration basins and/or swales can provide this secondary benefit.

Retention facilities provide the dual functions of stormwater quantity and quality control and may include both above and below ground components. These locations may exist as impoundments, collection and conveyance facilities (swales or perforated conduits), and on-site facilities such as parking lots and roadways using pervious pavements.

Design criteria for retention facilities are generally the same as those for detention facilities except that it may not be necessary to remove all runoff after each storm. The following additional criteria should be applied:

Wet Pond Facilities

- Shoreline protection shall be provided where erosion from wave action is expected
- Design should include a provision for lowering the pool elevation or draining the basin for cleaning purposes, shoreline maintenance, and emergency operations.
- Any dike or dam must be designed with a safety factor commensurate with an earth dam and/or as set forth in State statutes.
- Safety benching below the permanent water line at the toe of steep slopes to guard against accidental drowning
- Provide anti-seepage collars for pipes through impoundment structures/dams

Infiltration Facilities

- Sufficient infiltration capability to drain the basin within 24 hours to provide capacity for another event or increase the emergency spillway capacity and/or the volume of impoundment
- Additional engineering, soils testing and/or geological studies may be necessary
- Particulate collection device should be added to the inlet structure to allow particulate removal thet do not settle and preclude infiltration.

3.9 Stormwater Quality Treatment

All new development and redevelopment must provide on-site water quality treatment.

3.10 Stormwater Management/BMP Facilities Operation and Maintenance

As required by the Phase II Stormwater Regulations, the City/County must require the owners of new and redevelopment property to enter into a long-term maintenance plan

and agreement. This agreement requires nonresidential developments and multifamily property owners to:

- Conduct routine maintenance and perform any necessary structural repairs
- Complete annual self-inspection and submit documentation to the City/County of performance

For residential stormwater BMP facilities the City/County may maintain cleaning of impoundment structure and associated pipes and infrastructure related to long-term performance of the BMP. This maintenance generally does not include mowing or trash clean-up.

Refer to Post-Construction Runoff Ordinance for the City/County for additional information on long-term maintenance requirements and guidance. A copy of the City/County Stormwater Management/BMP Facilities Operation and Maintenance Agreement is found in Appendix G of this Document.

4.0 Watershed Analysis

4.1 Development Requirements

New developments where more than 5,000 square feet of impervious area will be added, or subdivisions of two or more lots (except for Rural Residential and Agricultural zoned properties), will require a watershed analysis to determine the effect of the post development runoff on downstream receiving waters and drainage. Such development projects will require that a hydrologic computer model created to generate and route runoff hydrographs of the design storm through the drainage network and to the downstream receiving waters. This requirement may be waived in the event the development is a single residential development or in cases where the City/County determines there will be no adverse impact to downstream receiving waters.

Additions of impervious areas less than 5,000 square feet require hydrologic analysis on a case by case basis, as determined by the City/County Engineer (depending on the location of the project and the capacity of downstream drainage structures).

4.2 Hydrologic Modeling

Any software package that uses the U.S.D.A. Natural Resource Conservation Service (formerly Soil Conservation Service, SCS) Unit Hydrograph method may be utilized in modeling the watershed.

The SCS Technical Release 55 Method (TR-55) will be used to calculate Time of Concentration and Curve Number values. The following methodology will be utilized in determining the modeling parameters:

- Drainage Area - Subcatchments should be arranged and sized as necessary to calculate hydrographs at critical points in the watershed such as the confluence of tributaries and the inlet to stormwater structures.
- Curve Number (CN) - Curve Numbers are listed in Table 4.2-1. Curve Numbers for a broad range of land uses are found in TR-55. SCS hydrological soil groups for all soil types in Franklin County are listed in Table 4.2-2. Copies of published SCS soil maps are contained in Appendix D.
- Lag Time (hag) - Lag Time is calculated as T_{Lag} = 0.6*(Tc), where (Tc) is the Time of Concentration. The minimum Tc is six minutes (0.1 hour). The maximum overland flow length used in calculating sheet flow travel time on pervious areas will be 150- feet.
- Time Step -The time step duration used by the hydrologic model is dependent on the Lag Time of the fastest draining subcatchment in the watershed. The maximum time step duration is calculated as t =0.29*(T_{Lag}) to avoid numerical instability.
- Storm Input- Design storms for input to the model are tabulated in Appendix A. Design storm applications are shown in Table 3.1-1.

Table 4.2-1 Curve Numbers

Land Use	Percent Impervious	Hydrologic Soil Group			
		A	B	C	D
Urban Areas					
Parking Lots, Roofs, Driveways, and Streets	100	98	98	98	98
Commercial Development	85	89	92	94	95
Industrial Development	72	81	88	91	93
Residential Development					
1/8 acre lots or less	65	77	85	90	92
¼ acre lots	38	61	75	83	87
1/3 acre lots	30	57	72	81	86
½ acre lots	25	54	70	80	85
1 acre lots	20	51	68	79	84
Pervious Areas					
Lawns, Parks, Golf Courses, Cemeteries, etc.	-	39	61	74	80
Pasture for Grazing (not mowed)	-	39	61	74	80
Meadows (mowed for hay)	-	30	58	71	78
Brushy Areas	-	30	48	65	73
Woods	-	30	55	70	77

Source: USDA Natural Resource Conservation Service

Table 4.2-2 SCS Hydrologic Group for Franklin County Soils

SCS Soil Series	Soil Symbol	SCS Hydrologic Soil Group
Ashton	As	B
Boonesboro	Bo	B
Faywood	Fd, Fe	C
Dunning	Du	D
Eden	Ef	C
Elk	Ek, El	B
Fairmount	Fa, Fe	D
Huntington	Hu	B
Lawrence	Lc	C
Lindside	Ld	C
Lowell	Lw	C
Maury	Ma	B
McAfee	Mc, Md	C
Melvin	Me	D
Nicholson	Nh	C
Newark	Ne	C
Nolin	No	B
Otwell	Ot	C
Rock Outcrop		D

Source: USDA Natural Resource Conservation Service

4.3 Extent of Study Area

The City/County may require a watershed study to extend downstream of a proposed development to determine the impact that the proposed development has on receiving waters including floodplains and existing downstream infrastructure. This is especially applicable to cases where future development downstream or in adjacent tributaries is anticipated.

The limit of downstream study shall be determined by the City/County Engineer on a case by case basis depending on the circumstances of each development but in general will be according to the following guidelines:

- In cases where a new development drains directly to a stream or river with a drainage area at least ten times the size of the new development, a downstream analysis may not be required.
- In cases where a new development drains through an existing structure or flood prone area with a total upstream drainage area less than ten times the size of the new development, a downstream analysis of the existing structure may be required.

4.4 Sinkholes

Drainage of post development runoff to a sinkhole will not be permitted unless the following requirements are satisfied:

- Stormwater detention is implemented that limits post development runoff rates flowing into the sinkhole to the pre-developed conditions for the 10-year 1-hour and 100-year 24 hour design storm, or a portion of the sinkhole drainage area is rerouted so that the post-developed runoff volume flowing to the sinkhole is no greater than the pre-developed volume.
- A permit to discharge to a Class V Underground Injection Well is obtained from Region 4 of the Environmental Protection Agency (EPA) and all water quality best management practices (BMP's) stipulated in the Underground Injection Control Program - Class V are implemented. Any other conditions of the permit must also be satisfied.

5.0 Development in Regulatory Waters

5.1 Requirements

Regulatory waters (Waters of the Commonwealth of Kentucky or Waters of the United States) are identified by any of the following attributes:

- Current Corps and State Streams
- A solid or dashed blue line on a 7.5 Minute USGS Quad Map
- Any waterway with a water line below which no vegetation normally exists
- Wetlands*

  * Wetlands are areas saturated by water at a frequency or duration sufficient to support a prevalence of vegetation adapted to life in saturated soils. Positive identification of wetlands may involve soil sampling/testing and generally requires the services of a professional.

Construction in regulatory waters requires a 401/404 Permit (Section 6.1). The following structures associated with new development are routinely permitted for construction in regulatory waters.

- Roadway, pedestrian, and utility crossings
- Channel/Pipe outfalls
- Bank Stabilization/Erosion Control measures

More extensive construction or relocation of regulatory waters will require mitigation measures such as erosion control or riparian improvements to the affected waters (or other regulatory waters), as provided for by the 401/404 permitting process.

5.2 Development Adjacent to Regulatory Waters

All new structures shall be built in accordance with the City/County Flood Damage Prevention Ordinance of the applicable jurisdiction.

6.0 Permits

6.1 401/404 Water Quality Permits

401 Certifications are administered by the Kentucky Division of Water (Water Resources Branch) while 404 Permits are administered to the U.S. Army Corps of Engineers (COE). Both involve construction in a stream or wetlands and are intended to limit the discharge of sediment or other contaminants to receiving waters, and to minimize loss of regulatory waters and associated aquatic habitats. The City/County will require a 401/404 permit or a letter from KDOW/COE stating that a permit is not required for all proposed construction in the waterway.

6.2 Floodplain Construction Permits

The Kentucky Division of Water (Floodplain Management Section) has the primary responsibility for the approval or denial of proposed construction and other activities in the 100-year floodplain of all streams in the Commonwealth. The permits cover bridges, dams, or fills of any kind, residential and commercial buildings, stream alterations or relocations, culverts, and pipe crossings above and below grade. The City/County will require a Floodplain Construction Permit or a letter from KDOW stating that a permit is not required for all proposed construction in the floodplain. The City/County Flood Damage Prevention Ordinance contains additional detail on requirements for construction permits.

6.3 KPDES General Stormwater Permits

KPDES General Stormwater Permits are administered by the Kentucky Division of Water and are required for sediment and erosion control of construction sites. The permit requires the following tasks to be performed. The City/County will not approve grading until proof of these submittals has been provided:

- Submission of Notice of Intent to KDOW
- Preparation of a best management practices (BMP) plan
- Identification and signatures of all contractors/subcontractors responsible for installation of an erosion control measure
- Site inspections by qualified personal per KYR100000
    - At least once every 7 calendar days, or
    - At least once every fourteen (14) calendar days and within 24-hours of a rainfall event of 0.5 inches or greater
- Notice of Termination to KDOW with certification that all discharges associated with construction have been eliminated

Refer to the Erosion Control and Sediment Control Measures Ordinance for the City/County for additional detail on requirements and the permitting process.

6.4 Local City/County Permits

City and County Permits and Approvals must be acquired prior to construction. Contact your local planning office for a listing of required permits specific to your site conditions and construction project type.

7.0 Submittals and Documentation

7.1 Requirements

All projects presented to the City/County for review involving construction of stormwater infrastructure shall incorporate the following information. Submitted documentation will generally be in the form of an organized notebook with a list of attachments and labeled dividers. A submittal checklist and sign-off sheet is contained in Appendix F.

7.2 Summation Sheet

- Certification signed and sealed by a Licensed Engineer

7.3 Hydrologic Information

- List of assumptions
- Computer Model Input/Output Summary Sheets
- 36"x 24" Plan View showing location of all sub-basins
- A table showing Drainage Area, Time of Concentration (Tc), Impervious Percentage, Curve Number (CN), and Peak Runoff Rate for each sub-basin.
- Expected future level of development in upstream watersheds

7.4 Inlets, Storm Sewers, and Manholes

- List of assumptions
- Computer Model Input/Output Summary Sheets or hand computations
- Plan View showing the following:
    - Drainage areas
    - Street Layout, lot boundaries
    - Catch basins with type, station and offset, invert elevation
    - Pipes with size, type, slope
    - Manholes with size and type, station and offset
    - Headwalls with type, invert elevation
    - Utilities
    - Flow arrows
    - Existing and proposed 2-foot contours
    - Details

- Profile showing the following:
    - Underground Utility Crossings
    - Existing and proposed ground surfaces
    - Curb inlets with type and elevation
    - Manholes with type and elevation
    - Pipes with size, slope, type, class, length
    - Headwall type and elevations
    - Proposed peak flow
    - Hydraulic grade line

7.5 Culverts and Bridges

- List of assumptions
- Copies of computer summary sheets
- Allowable headwater and minimum top of roadway elevation
- Culvert performance curves and type of control
- Outlet erosion control/energy dissipation measures

7.6 Constructed Channels

- List of assumptions
- Profiles showing channel invert, 100-year water surface, and velocity
- Cross-sections used for capacity determination and location
- Design analysis for channel lining stability
- Energy dissipation design and calculations
- Copies of computer analysis

7.7 Detention Ponds

- Plan view showing 1-foot contours, utilities, and principal/emergency spillways
- Design calculations
- Drainage area map
- Embankment cross section
- Top of embankment and peak stage elevations
- Principal spillway details
- Emergency Spillway Details

7.8 Erosion and Sediment Control Plan

Site Map showing the following:

- Pre-construction topography showing drainage ways, property limits, construction limits, trees to be preserved, and utilities
- Finished grades, building locations, paved areas, construction entrances, access and haul roads, stockpile areas, and equipment storage areas
- Location of all planned BMP's
- Areas not to be disturbed

Description of the following:

- Location and size of disturbance area
- Beginning and completion dates
- Construction sequencing
- Listing of erosion and sediment control BMP's

7.9 Record Drawings

Record drawings shall be submitted at the end of construction. A list of all deviations from approved construction plans, with explanation of each, will be submitted with the record drawings.

8.0 Responsibilities

8.1 Purpose

The following record of responsibilities of the City/County, Developer, and Developer's Engineer is provided to eliminate ambiguity as to who will be responsible for a specific task or performance.

8.2 Responsibilities of the City/County

- Comply with all City/County requirements regarding infrastructure development
- Make decisions and carry out responsibilities in a timely manner

8.3 Responsibilities of the Developer

- Comply with all City/County requirements regarding infrastructure development
- Select an Engineer to design the infrastructure and inspect the construction
- Select a construction contractor to construct the infrastructure and assume all related cost
- Conduct periodic inspections during construction to ensure satisfactory progress
- Construct the infrastructure in accordance with the approved or submitted documents and provide unlimited access to the City/County during design and construction
- Obtain all local, state, and federal permits
- Complete long-term maintenance agreement and establish long term maintenance plan and responsibility, if required

8.4 Responsibilities of the Developer's Engineer

- Comply with all City/County requirements regarding infrastructure development
- Prepare plans, specifications, and other submittals in accordance with City/County requirements
- Provide construction inspection services
- Prepare record drawings of the completed infrastructure
- Be responsible for the technical accuracy of its services and all resulting documentation, and acknowledge that the City/County will not be responsible for discovering deficiencies or errors therein.
- Attend neighborhood and City/County meetings as required

Appendix A

Design Storm
Time vs. Depth Tabulations

1-Hour Rainfall Distribution

	Cumulative Depth	
Time	10-Year	100-Year
(min)	(in)	(in)
0:00	0.00	0.00
0:03	0.04	0.06
0:06	0.11	0.16
0:09	0.20	0.29
0:12	0.31	0.46
0:15	0.45	0.65
0:18	0.65	0.93
0:21	0.93	1.35
0:24	1.23	1.79
0:27	1.48	2.15
0:30	1.65	2.38
0:33	1.71	2.48
0:36	1.76	2.55
0:39	1.80	2.61
0:42	1.84	2.66
0:45	1.87	2.71
0:48	1.90	2.76
0:51	1.93	2.80
0:54	1.96	2.84
0:57	1.98	2.87
1:00	2.00	2.90

6-Hour Rainfall Distribution

	Cumulative Depth	
Time	10-Year	100 Year
(min)	(in)	(in)
0:00	0.00	0.00
0:10	0.02	0.03
0:20	0.04	0.06
0:30	0.06	0.10
0:40	0.09	0.13
0:50	0.12	0.17
1:00	0.14	0.22
1:10	0.16	0.26
1:20	0.20	0.31
1:30	0.24	0.37
1:40	0.28	0.43
1:50	0.33	0.51
2:00	0.38	0.58
2:10	0.43	0.67
2:20	0.50	0.78
2:30	0.59	0.89
2:40	0.63	1.26
2:50	1.42	2.18

	Cumulative Depth	
Time	10-Year	100 Year
(min)	(in)	(in)
3:00	2.25	3.46
3:10	2.39	3.65
3:20	2.49	3.82
3:30	2.57	3.94
3:40	2.63	4.03
3:50	2.68	4.12
4:00	2.73	4.20
4:10	2.78	4.27
4:20	2.82	4.32
4:30	2.85	4.37
4:40	2.89	4.43
4:50	2.92	4.47
5:00	2.95	4.51
5:10	2.97	4.56
5:20	3.00	4.60
5:30	3.02	4.64
5:40	3.04	4.68
5:50	3.07	4.71
6:00	3.09	4.74

24-Hour Rainfall Distribution

	Cumulative Depth	
Time	10-Year	100 Year
(min)	(in)	(in)
0:00	0.00	0.00
0:10	0.01	0.01
0:20	0.01	0.02
0:30	0.02	0.03
0:40	0.03	0.04
0:50	0.04	0.05
1:00	0.04	0.06
1:10	0.05	0.08
1:20	0.06	0.09
1:30	0.06	0.10
1:40	0.07	0.11
1:50	0.08	0.12
2:00	0.09	0.13
2:10	0.09	0.14
2:20	0.10	0.15
2:30	0.11	0.16
2:40	0.12	0.17
2:50	0.12	0.18
3:00	0.13	0.19
3:10	0.14	0.20
3:20	0.14	0.22
3:30	0.15	0.23
3:40	0.16	0.24
3:50	0.17	0.26
4:00	0.19	0.28
4:10	0.20	0.30
4:20	0.22	0.32
4:30	0.23	0.34
4:40	0.25	0.37
4:50	0.26	0.39
5:00	0.27	0.41
5:10	0.29	0.43
5:20	0.30	0.45
5:30	0.32	0.47
5:40	0.33	0.50
5:50	0.35	0.52
6:00	0.36	0.54
6:10	0.37	0.56
6:20	0.38	0.58
6:30	0.39	0.60
6:40	0.41	0.62
6:50	0.42	0.65
7:00	0.44	0.67
7:10	0.45	0.69
7:20	0.47	0.71
7:30	0.48	0.73
7:40	0.49	0.75
7:50	0.51	0.78
8:00	0.52	0.80
8:10	0.54	0.82
8:20	0.56	0.85
8:30	0.58	0.88
8:40	0.60	0.92
8:50	0.62	0.95
9:00	0.65	0.98
9:10	0.67	1.01
9:20	0.69	1.04
9:30	0.71	1.08
9:40	0.73	1.11
9:50	0.76	1.15
10:00	0.79	1.20
10:10	0.82	1.24
10:20	0.86	1.29
10:30	0.89	1.35
10:40	0.93	1.41
10:50	0.98	1.48
11:00	1.03	1.55
11:10	1.09	1.64
11:20	1.15	1.75
11:30	1.23	1.86
11:40	1.47	2.22
11:50	20.52	3.11
12:00	2.88	4.36
12:10	3.01	4.56
12:20	3.12	4.72
12:30	3.20	4.84
12:40	3.26	4.92
12:50	3.30	5.01
13:00	3.35	5.08
13:10	3.40	5.15
13:20	3.43	5.20
13:30	3.47	5.26
13:40	3.51	5.31
13:50	3.53	5.35
14:00	3.56	5.40
14:10	3.59	5.44
14:20	3.62	5.48
14:30	3.64	5.52
14:40	3.66	5.55
14:50	3.69	5.58
15:00	3.71	5.61
15:10	3.73	5.64
15:20	3.75	5.68
15:30	3.77	5.71
15:40	3.79	5.74
15:50	3.82	5.77
16:00	3.83	5.80
16:10	3.85	5.82
16:20	3.86	5.84
16:30	3.87	5.86
16:40	3.89	5.87
16:50	3.90	5.90
17:00	3.92	5.93
17:10	3.93	5.95
17:20	3.95	5.97
17:30	3.96	5.99
17:40	3.97	6.01
17:50	3.98	6.03
18:00	3.99	6.05
18:10	4.01	6.08
18:20	4.02	6.10
18:30	4.04	6.12
18:40	4.05	6.14
18:50	4.07	6.16
19:00	4.08	6.18
19:10	4.09	6.21
19:20	4.11	6.23
19:30	4.12	6.25
19:40	4.14	6.27
19:50	4.15	6.29
20:00	4.17	6.31
20:10	4.17	6.32
20:20	4.18	6.33
20:30	4.19	6.35
20:40	4.20	6.36
20:50	4.20	6.37
21:00	4.21	6.38
21:10	4.22	6.39
21:20	4.22	6.40
21:30	4.23	6.41
21:40	4.24	6.42
21:50	4.25	6.43
22:00	4.25	6.44
22:10	4.26	6.45
22:20	4.27	6.46
22:30	4.28	6.47
22:40	4.28	6.49
22:50	4.29	6.50
23:00	4.30	6.51
23:10	4.30	6.52
23:20	4.31	6.53
23:30	4.32	6.54
23:40	4.33	6.55
23:50	4.33	6.56
24:00	4.34	6.57

Appendix B

Sag Inlet Capacity Charts

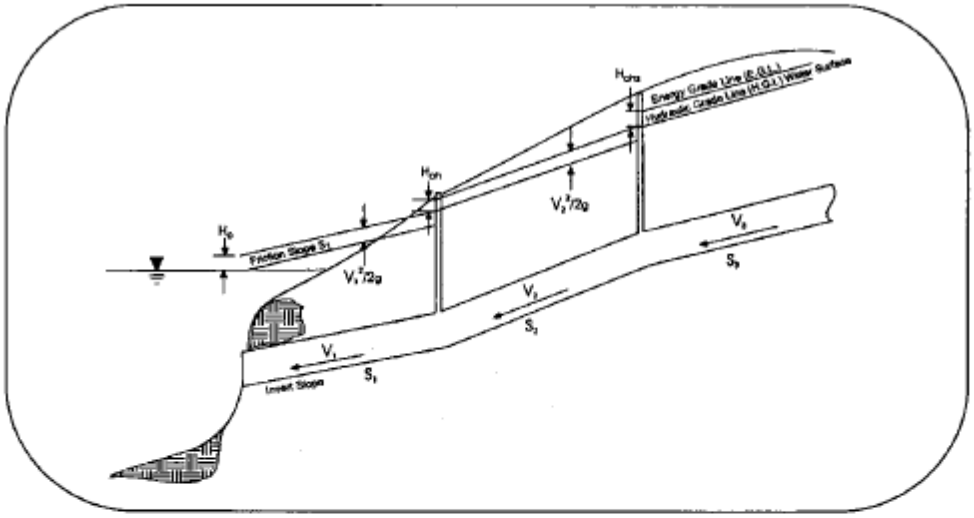
Publication No. FHWA-NHI-10-009
September 2009
(Revised August 2013)

U.S. Department of Transportation

Federal Highway Administration

Hydraulic Engineering Circular No. 22, Third Edition

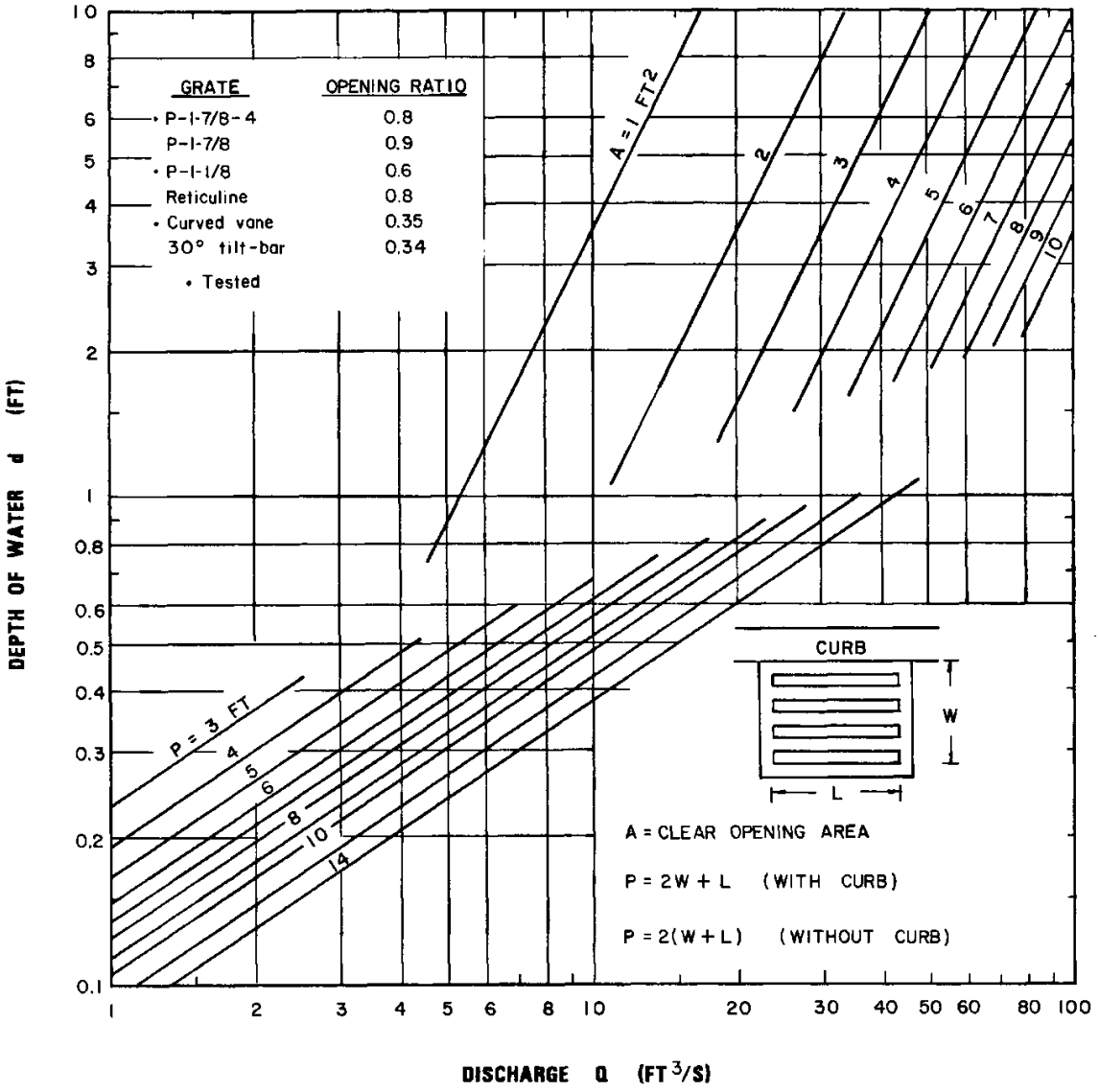
URBAN DRAINAGE DESIGN MANUAL



NATIONAL HIGHWAY INSTITUTE

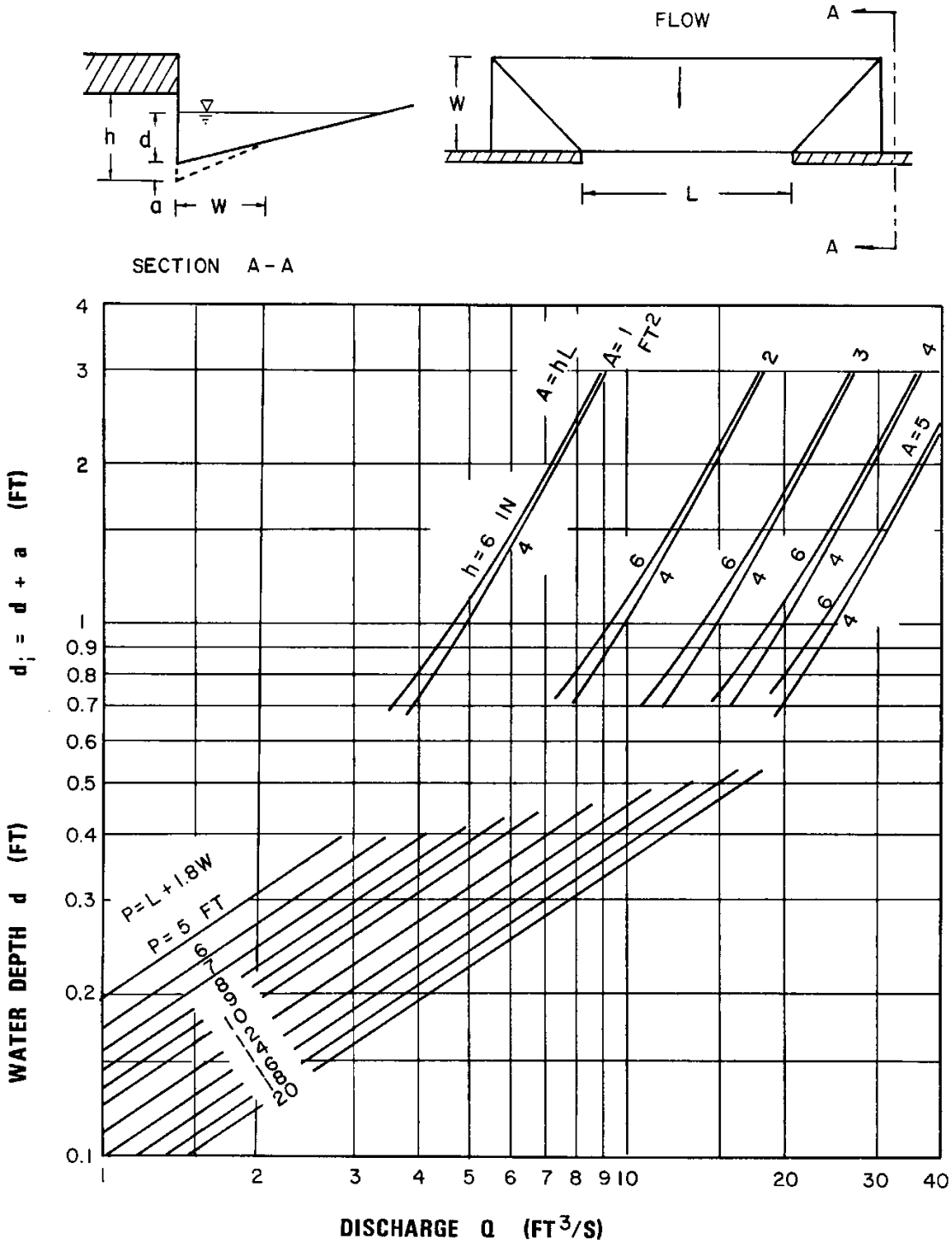
Training Solutions for Transportation Excellence

CHART 9B



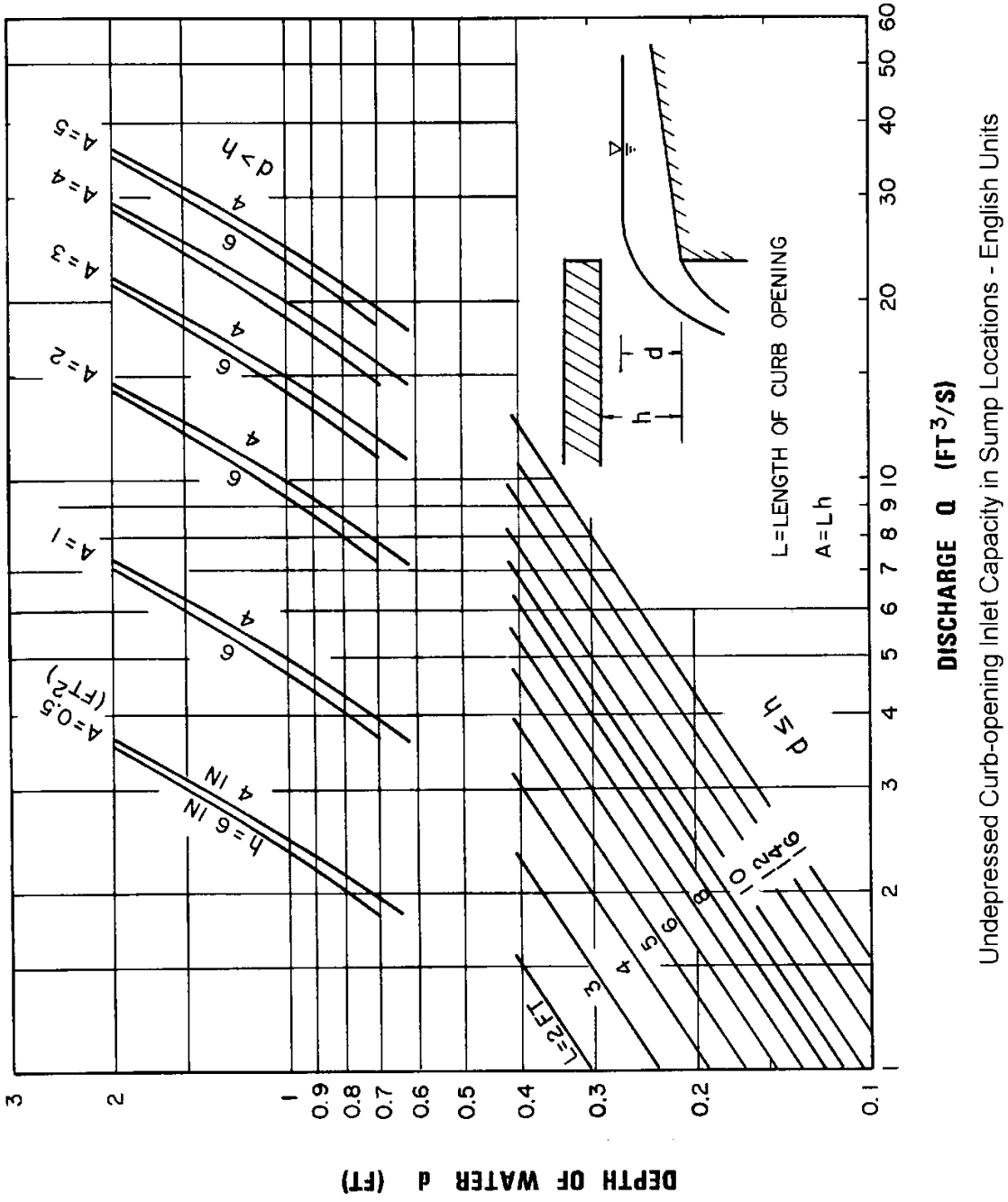
Grate Inlet Capacity in Sump Conditions - English Units

CHART 10B



Depressed Curb-opening Inlet Capacity in Sump Locations - English Units

CHART 11B



Undepressed Curb-opening Inlet Capacity in Sump Locations - English Units

Appendix C

Time of Concentration/Curve Number Worksheets

Worksheet 3: Time of Concentration (T_c) or travel time (T_t)

Project	By	Date
Location	Checked	Date

Check one: ☐ Present ☐ Developed

Check one: ☐ T_c ☐ T_t through subarea

Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)

	Segment ID		
1. Surface description (table 3-1)			
2. Manning's roughness coefficient, n (table 3-1)			
3. Flow length, L (total L † 300 ft) ft			
4. Two-year 24-hour rainfall, P_2 in			
5. Land slope, s ft/ft			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr		+	=

Shallow concentrated flow

	Segment ID		
7. Surface description (paved or unpaved)			
8. Flow length, L ft			
9. Watercourse slope, s ft/ft			
10. Average velocity, V (figure 3-1) ft/s			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t hr		+	=

Channel flow

	Segment ID		
12. Cross sectional flow area, a ft^2			
13. Wetted perimeter, p_w ft			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft			
15 Channel slope, s ft/ft			
16. Manning's roughness coefficient, n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ft/s			
18. Flow length, L ft			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t hr		+	=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) Hr

Worksheet 2: Runoff curve number and runoff

Project	By	Date
Location	Checked	Date

Check one: ☐ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Figure 2-3	CN 1/ Figure 2-4	Area ☐ acres ☐ mi² ☐ %	Product of CN x area
1/ Use only one CN source per line				Totals ➡		

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = _____ = _____ ; Use CN ➡ ☐

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency	yr			
Rainfall, P (24-hour)	in			
Runoff, Q	in			

(Use P and CN with table 2-1, figure 2-1, or equations 2-3 and 2-4)

Appendix D

SCS Soil Maps

USDA Web Soil Survey (WSS) provides soil data and information produced by the National Cooperative Soil Survey. It is operated by the USDA Natural Resources Conservation Service (NRCS). The site is updated and maintained online as the single authoritative source of soil survey information. Interactive soil data and maps may be found at the following web link:

https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

The Soil Survey of Anderson and Franklin Counties Kentucky may be found at the following web link:

https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/kentucky/KY601/0/anderson.pdf

Appendix E

Sample Calculations for Rational Method, Manning's Equation, and Tractive Force Method

Sample Calculations

Rational Method: Q =CIA

Where: Q =Peak Runoff Rate (cfs)
C =Land Use Coefficient (dimensionless)
I = Rainfall Intensity (in/hr)
A= Drainage Area (acres)

Sample: 3.5 acre basin with 60% impervious area and 40% grassed landscape. Find 10-year peak runoff rate.

Weighted C Factor: C = 60% (0.95) + 40% (0.20) = 0.65
I = 6.0 in/hr (from Table 2.1-2 w/Tc = 6 min)
Q = 0.65 x 6.0 (in/hr) x 3.5 acres= 13.6 cfs

Typical C Factors

Land Use	C
Impervious Areas	0.95
Grassed, Wooded, Pasture, Farmed Areas:	
Slope ≤ 7%	0.20
Slope > 7%	0.30
Compacted Earth/Gravel	0.80

Sample Calculations

Manning Equation: $V = \frac{1.49}{N} R^{2/3} S^{1/2}$

Alternatively: $Q = \frac{1.49}{N} R^{2/3} S^{1/2} A$

Where:

V = Velocity (fps)
N = Manning's N (see Table 2.4-1)
R = Hydraulic Radius = Flow Area (A) / Wetted Perimeter (P) (ft)
S = Friction Slope (ft/ft)
A = Flow Area (ft^2)
P = Wetted Perimeter (ft)
Q= Flow Rate (cfs)

Sample:

Given: Grass lined open channel with bottom width of 5 feet, 3H:1V side slope, and channel slope of 2%.

Find: Normal Depth (Y) for Q = 1,200 cfs

$A = (5 + 3Y) \times Y$
$P = 5 + 2(Y^2 + (3Y)^2)^{1/2}$
N = 0.045 (Table 2.4-1)
S = 0.02
Q = 1,200

$$1{,}200 = \frac{1.49}{0.045} \frac{[(5 + 3Y)Y]^{5/3} (0.02)^{1/2}}{(5+2Y10^{1/2})^{2/3}}$$

$$1.68 \times 107 = \frac{[(5 + 3Y)Y]^5}{[5 + 2Y10^{1/2}]^2}$$

Root Solve: Y = 5.6 feet

Find: Required freeboard for above channel (required freeboard is the larger of 1 foot or 2 velocity heads)

Velocity Head = V2
V = Q/A = 1,200/122 = 9.8 fps
Velocity Head = $(9.8)^2/2(32.2)$ = 1.49
Required Freeboard = 3.0 feet

Sample Calculations

Tractive Force Method: $\tau = 62.4YS$

Where: τ = Tractive Force (lbs/ft^2)
Y = Normal Depth (ft)
S = Channel Slope (ft/ft)

Sample: Find the tractive force (shear stress) exerted upon the grass channel in the previous example.

Y = 5.6 ft
S = 0.02

τ = (62.4 lbs/ft^3) (5.6 ft) (0.02) = 7.0 lbs/ft^2

From Table 2.4-2, the maximum allowable shear stress for a grass channel is 1.0 lb/ft2; thus the grass lining is not acceptable. Recommend a gabion mattress or armored channel lining.

This is an iterative process since selecting a new channel lining will change Manning's N, resulting in a different normal depth.

Appendix F

Submittal Checklist and Signoff

Improvement Plan Submittal Checklist

The items below shall be submitted to the City/County along with the plans and specifications. Submitted documentation will generally be in the form of an organized notebook with a list of attachments and labeled dividers. If any item on this checklist is not applicable to a particular submittal, a sheet of paper with an explanation of the absence of that item shall be included in place of the omitted item. This checklist, signed and stamped by a professional civil engineer, will be included in the front of the submittal notebook.

1. Grading and Erosion/Sediment Control Plan
2. Hydrologic documentation
3. Post development floodplain and analysis
4. Design documentation for all stormwater appurtenances
5. List of all local, state, and federal permits that will be obtained

I hereby certify that the improvements plans, calculations, and other documents submitted herein have been prepared in accordance with the City of Frankfort or Franklin County, Kentucky regulations and ordinances in effect at the time of submission.

_____ _____

Signature and Registration Number Date

LD Permit #_____

TYPE I LAND DISTURBANCE PERMIT APPLICATION
CITY OF FRANKFORT

Note: The application form and supporting documentation must be completed in its entirety and delivered to **City of Frankfort Public Works Department**, to begin the review process. The omission of required items may be cause for rejection of the submittal without review.

Project Name: _____

Project Address: _____

Subdivision Name/Lot No.: _____

Total Area of Project Site (Acres): _____ Total Area of Land Disturbance Activities (SF): _____

Property Owner: _____ Contact Person: _____

Mailing Address: _____

Telephone: _____ Fax: _____

Mobile: _____ E-mail Address: _____

Builder: _____ Contact Person: _____

Company Name: _____

Mailing Address: _____

Telephone: _____ Fax: _____

Mobile: _____ E-mail Address: _____

I hereby certify that all clearing, grading, construction, or development will conform to City of Frankfort, Chapter 53 Erosion and Sediment Control Measures Ordinance and I have received and reviewed the Schematic Erosion Prevention and Sediment Control Plan and Standard BMP Details for stormwater quality control measures for small sites.

_____ _____

Owner or Authorized Agent Date

All construction activities require the following control measures:

- ✓ Stable construction exit at all points of entrance and egress
- ✓ Sediment control measures for sheet flow measures (e.g. silt fence)
- ✓ Sediment control measures for concentrated flow measures (e.g. rock check dams)
- ✓ Storm sewer inlet protection

Approved By:

_____ _____

Public Works Department Date

LD Permit #_____

TYPE II LAND DISTURBANCE PERMIT APPLICATION
CITY OF FRANKFORT

Note: The application form and supporting documentation must be completed in its entirety and delivered to **City of Frankfort Public Works Department**, to begin the review process. The omission of required items may be cause for rejection of the submittal without review.

Project Name: _____

Project Address: _____

Subdivision Name/Lot No.: _____

Total Area of Project Site (Acres): _____ Total Area of Land Disturbance Activities (SF): _____

Property Owner: _____ Contact Person: _____

Mailing Address: _____

Telephone: _____ Fax: _____

Mobile: _____ E-mail Address: _____

Developer: _____ Contact Person: _____

Mailing Address: _____

Telephone: _____ Fax: _____

Mobile: _____ E-mail Address: _____

Designer: _____ Contact Person: _____

Mailing Address: _____

Telephone: _____ Fax: _____

Mobile: _____ E-mail Address: _____

Site Contractor: _____ Contact Person: _____

Mailing Address: _____

Telephone: _____ Fax: _____

Mobile: _____ E-mail Address: _____

I hereby certify that all land disturbing construction and associated activity pertaining to this permit application shall be accomplished pursuant to the approved plans and Chapter 53 Erosion and Sediment Control Measures Ordinance.

_____ _____

Owner or Authorized Agent Date

TYPE II LAND DISTURBANCE PERMIT EPSC PLAN CHECKLIST

Construction Plan Elements

- ☐ Vicinity map showing project location
- ☐ Location of all lots and proposed site improvements (roads, utilities, structures, etc.)
- ☐ 100-year floodplain and floodway limits
- ☐ Locations, size, and dimensions of proposed stormwater systems (pipes, swales, channels, etc.)
- ☐ Offsite construction activities (utility connections, etc.)
- ☐ Current Zoning
- ☐ Location of soil stockpiles and/or borrow/disposal areas
- ☐ Existing vegetative cover
- ☐ Proposed vegetative cover
- ☐ Existing site topography (minimum 2' interval)
- ☐ Proposed final topography (minimum 2' interval)

Erosion Prevention and Sediment Control Plan Elements

- ☐ Narrative describing the nature and purpose the project
- ☐ Vicinity map showing project location
- ☐ Notation of any State or Federal water quality permits
- ☐ Specific points where the stormwater discharge will leave the site
- ☐ Location and name of all wetlands, lakes, sinkholes, and watercourses on or adjacent to the site
- ☐ Identification of all receiving waters
- ☐ Identification of potential discharges to ground water (abandoned wells, sinkholes, etc.)
- ☐ 100-year floodplain and floodway limits
- ☐ Pre- and post-construction estimate of peak runoff (per Stormwater Design Standards)
- ☐ Adjacent landuse, including upstream watershed
- ☐ Locations and approximate boundaries of all disturbed areas (construction limits)
- ☐ Soils map including soil descriptions and limitations
- ☐ Locations, size, and dimensions of proposed stormwater systems (pipes, swales, channels, etc.)
- ☐ Location of soil stockpiles and/or borrow/disposal areas
- ☐ Signed statement by owner or authorized agent that all land disturbing activities will be done pursuant to the approved Chapter 53 Erosion and Sediment Control Measures Ordinance.
- ☐ Sequence describing stormwater quality measure implementation relative to land disturbance activities
- ☐ Stable construction exit locations and specifications (at all points of ingress and egress)
- ☐ Sediment control measures for sheet flow areas
- ☐ Sediment control measures for concentrated flow areas
- ☐ Storm sewer inlet protection measure locations and specifications
- ☐ Runoff control measures (diversions, rock, check dams, slope drains, etc.)
- ☐ Stormwater outlet protection specifications
- ☐ Grade stabilization structure location specifications
- ☐ Location, dimensions, specifications, and construction details of each stormwater quality measure
- ☐ Temporary surface stabilization methods appropriate for each season (include sequencing)
- ☐ Permanent surface stabilization specifications (include sequencing)
- ☐ Computations to support sediment control designs
- ☐ Kentucky Licensed Professional Engineer's seal

LD Permit #_____

TYPE I LAND DISTURBANCE PERMIT APPLICATION
FRANKLIN COUNTY

Note: The application form and supporting documentation must be completed in its entirety and delivered to **Franklin County Planning and Building Codes Department**, to begin the review process. The omission of required items may be cause for rejection of the submittal without review.

Project Name: _____

Project Address: _____

Subdivision Name/Lot No: _____

Total Area of Project Site (Acres): _____ Total Area of Land Disturbance Activities (SF): _____

Description:

Property Owner: _____ Contact Person: _____

Mailing Address: _____

Telephone: _____ Fax: _____

Mobile: _____ E-mail Address: _____

Builder: _____ Contact Person: _____

Company Name: _____

Mailing Address: _____

Telephone: _____ Fax: _____

Mobile: _____ E-mail Address: _____

I hereby certify that all clearing, grading, construction, or development will conform with Franklin County Ordinance No. 6, 2005 Series and I have received and reviewed the Schematic Erosion Prevention and Sediment Control Plan and Standard BMP Details for storm water quality control measures for small sites.

_____ _____

Owner or Authorized Agent Date

All construction activities require the following control measures:

- ✓ Stable construction exit at all points of entrance and egress
- ✓ Sediment control measures for sheet flow measures (e.g. silt fence)
- ✓ Sediment control measures for concentrated flow measures (e.g. rock check dams)
- ✓ Storm sewer inlet protection

Approved By:

_____ _____

Planning and Building Codes Department Date

LD Permit #_____

TYPE II LAND DISTURBANCE PERMIT APPLICATION
FRANKLIN COUNTY

Note: The application form and supporting documentation must be completed in its entirety and delivered to **Franklin County Planning and Building Codes Department**, to begin the review process. The omission of required items may be cause for rejection of the submittal without review.

Project Name: _____

Project Address: _____

Subdivision Name/Lot No.: _____

Total Area of Project Site (Acres): _____ Total Area of Land Disturbance Activities: _____

Property Owner: _____ Contact Person: _____

Mailing Address: _____

Telephone: _____ Fax: _____

Mobile: _____ E-mail Address: _____

Developer: _____ Contact Person: _____

Mailing Address: _____

Telephone: _____ Fax: _____

Mobile: _____ E-mail Address: _____

Designer: _____ Contact Person: _____

Mailing Address: _____

Telephone: _____ Fax: _____

Mobile: _____ E-mail Address: _____

Site Contractor: _____ Contact Person: _____

Mailing Address: _____

Telephone: _____ Fax: _____

Mobile: _____ E-mail Address: _____

I hereby certify that all clearing, grading, construction, or development will conform with the Franklin County Ordinance No. 6, 2005 Series and I have received and reviewed the Schematic Erosion Prevention and Sediment Control Plan and Standard BMP Details for storm water quality control measures for small sites.

_____ _____

Owner or Authorized Agent Date

Approved by:

_____ _____

Planning and Building Codes Department Date

TYPE II LAND DISTURBANCE PERMIT EPSC PLAN CHECKLIST

Construction Plan Elements

- ☐ Vicinity map showing project location
- ☐ Location of all lots and proposed site improvements (roads, utilities, structures, etc.)
- ☐ 100-year floodplain and floodway limits
- ☐ Locations, size, and dimensions of proposed stormwater systems (pipes, swales, channels, etc.)
- ☐ Offsite construction activities (utility connections, etc.)
- ☐ Current Zoning
- ☐ Location of soil stockpiles and/or borrow/disposal areas
- ☐ Existing vegetative cover
- ☐ Proposed vegetative cover
- ☐ Existing site topography (minimum 2' interval)
- ☐ Proposed final topography (minimum 2' interval)

Erosion Prevention and Sediment Control Plan Elements

- ☐ Narrative describing the nature and purpose of the project
- ☐ Vicinity map showing project location
- ☐ Notation of any State or Federal water quality permits
- ☐ Specific points where the stormwater discharge will leave the site
- ☐ Location and name of all wetlands, lakes, sinkholes, and watercourses on or adjacent to the site
- ☐ Identification of all receiving waters
- ☐ Identification of potential discharges to ground water (abandoned wells, sinkholes, etc.)
- ☐ 100-year floodplain and floodway limits
- ☐ Pre- and post-construction estimate of peak runoff (per Stormwater Design Standards)
- ☐ Adjacent landuse, including upstream watershed
- ☐ Locations and approximate boundaries of all disturbed areas (construction limits)
- ☐ Soils map including soil descriptions and limitations
- ☐ Locations, size, and dimensions of proposed stormwater systems (pipes, swales, channels, etc.)
- ☐ Location of soil stockpiles and/or borrow/disposal areas
- ☐ Signed statement by owner or authorized agent that all land disturbing activities will be done pursuant to the approved EPSC and Ordinance No. 6, 2005 series.
- ☐ Sequence describing stormwater quality measure implementation relative to land disturbance activities
- ☐ Stable construction exit locations and specifications (at all points of ingress and egress)

- ☐ Sediment control measures for sheet flow areas
- ☐ Sediment control measures for concentrated flow areas
- ☐ Storm sewer inlet protection measure locations and specifications
- ☐ Runoff control measures (diversions, rock check dams, slope drains, etc.)
- ☐ Storm water outlet protection specifications
- ☐ Grade stabilization structure locations and specifications
- ☐ Location, dimensions, specifications, and construction details of each stormwater quality measure
- ☐ Temporary surface stabilization methods appropriate for each season (include sequencing)
- ☐ Permanent surface stabilization specifications (include sequencing)
- ☐ Computations to support sediment control designs
- ☐ Kentucky Licensed Professional Engineer’s seal

Appendix G

Stormwater Management/BMP Facilities Operation and Maintenance Agreement

STORMWATER MANAGEMENT/BMP FACILITIES
OPERATION AND MAINTENANCE AGREEMENT

THIS AGREEMENT, made and entered into this ___ day of _____, 20___, by and between (Insert Full Name of Owner)_____hereinafter called the "Landowner", and City of Frankfort/Franklin County, hereinafter called the "City"/"County". WITNESSETH, that WHEREAS, the Landowner is the owner of certain real property described as (Franklin County tax Map/Parcel Identification Number) _____ as recorded by deed in the land records of Franklin County, Kentucky, Deed Book _____ Page _____, hereinafter called the "Property".

WHEREAS, the Landowner is proceeding to build on and develop the property; and

WHEREAS, the Site Plan/Subdivision Plan known as _____ (Name of Plan/Development), hereinafter called the "Plan", which is expressly made a part hereof, as approved or to be approved by the City/County, provides for detention and/or treatment of stormwater within the confines of the property; and

WHEREAS, the City/County and the Landowner, its successors and assigns, including any homeowners association, agree that the health, safety, and welfare of the residents of Frankfort/Franklin County, Kentucky require that on-site stormwater management/BMP facilities be constructed and maintained on the Property; and

WHEREAS, the City requires that on-site stormwater management/BMP facilities as shown on the Plan be constructed and adequately maintained by the Landowner, its successors and assigns, including any homeowners association.

NOW, THEREFORE, in consideration of the foregoing premises, the mutual covenants contained herein, and the following terms and conditions, the parties hereto agree as follows:

1. The on-site stormwater management/BMP facilities shall be constructed by the Landowner, its successors and assigns, in accordance with the plans and specifications identified in the Plan.

2. The Landowner, its successors and assigns, including any homeowners association, shall adequately maintain the stormwater management/BMP facilities. This includes all pipes and channels built to convey stormwater to the facility, as well as all structures, improvements, and vegetation provided to control the quantity and quality of the stormwater. Adequate maintenance is herein defined as good working condition so that these facilities are performing their design functions. The Annual Inspection Report is to be used to establish if the working condition of the facility is acceptable to the City.

3. The Landowner, its successors and assigns, shall inspect the stormwater management/BMP facility and submit an inspection report annually. The purpose of the inspection is to assure safe and proper functioning of the facilities. The inspection shall cover the entire facilities, berms, outlet structure, pond areas, access roads, etc. Deficiencies shall be noted in the inspection report.

4. The Landowner, its successors and assigns, hereby grant permission to the City/County, its authorized agents and employees, to enter upon the Property and to inspect the stormwater management/BMP facilities whenever the City/County deems necessary. The purpose of inspection is to follow-up on reported deficiencies and/or to respond to citizen complaints. The City/County shall provide the Landowner, its successors and assigns, copies of the inspection findings and a directive to commence with the repairs if necessary.

5. In the event the Landowner, its successors and assigns, fails to maintain the stormwater management/BMP facilities in good working condition acceptable to the City/County, the City/County may enter upon the Property and take whatever steps necessary to correct deficiencies identified in the inspection report and to charge the costs of such repairs to the Landowner, its successors and assigns. This provision shall not be construed to allow the City/County to erect any structure of permanent nature on the land of the Landowner outside of the easement for the stormwater

management/BMP facilities. It is expressly understood and agreed that the City/County is under no obligation to routinely maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the City/County.

6. The Landowner, its successors and assigns, will perform the work necessary to keep these facilities in good working order as appropriate. In the event a maintenance schedule for the stormwater management/BMP facilities (including sediment removal) is outlined on the approved plans, the schedule will be followed.
7. In the event the City/County pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Landowner, its successors and assigns, shall reimburse the City/County upon demand, within thirty (30) days of receipt thereof for all actual costs incurred by the City/County hereunder.
8. This Agreement imposes no liability of any kind whatsoever on the City/County and the Landowner agrees to hold the City/County harmless from any liability in the event the stormwater management/BMP facilities fail to operate properly.
9. This Agreement shall be recorded among the land records of Franklin County, Kentucky, and shall constitute a covenant running with the land, and shall be binding on the Landowner, its administrators, executors, assigns, heirs and any other successors in interests, including any homeowners association.

WITNESS the following signatures and seals:

_____
Company/Corporation/Partnership Name (Seal)

By: _____

_____
(Type Name)

_____

(Type Title)

STATE OF KENTUCKY

COUNTY OF FRANKLIN

The foregoing Agreement was acknowledged before me this ____ day of _____, 20___, by

_____.

_____
NOTARY PUBLIC

My Commission Expires: _____

CITY OF FRANKFORT, KENTUCKY

By: _____

_____
(Name)

_____
(Title)

STATE OF KENTUCKY

COUNTY OF FRANKLIN

The foregoing Agreement was acknowledged before me this ____ day of _____, 20___, by

_____.

_____
NOTARY PUBLIC

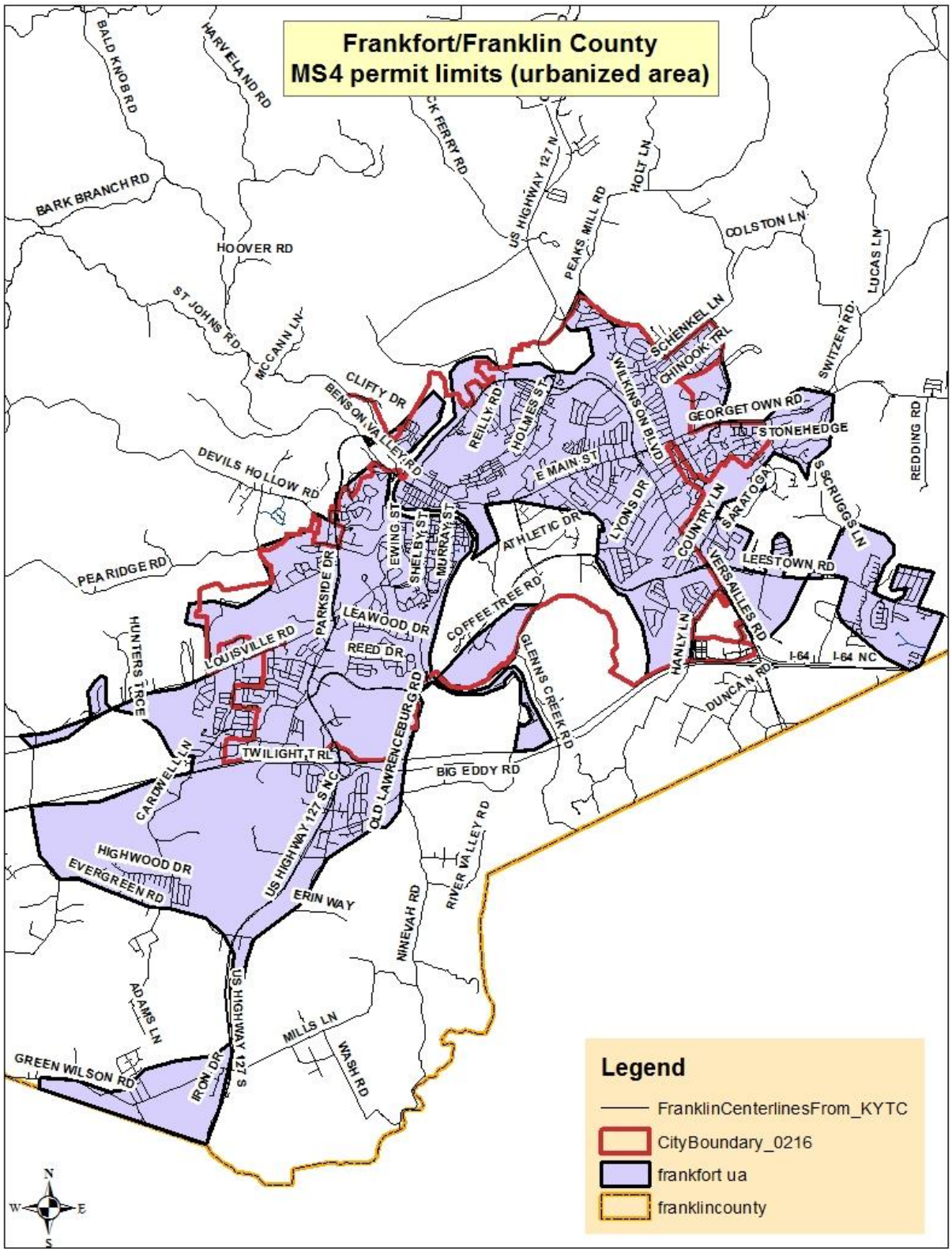
My Commission Expires: _____

Approved as to Form:

_____ _____
City/County Attorney Date

Appendix H

MS4 permit limits map


Frankfort/Franklin County
MS4 permit limits (urbanized area)
BALD KNOB RD
HARVELAND RD
BARK BRANCH RD
HOOVER RD
ST JOHNS RD
MCCANN LN
CLIFTY DR
BENSON VALLEY RD
DEVILS HOLLOW RD
PEA RIDGE RD
HUNTERS TRCE
LOUISVILLE RD
PARKSIDE DR
LEAWOOD DR
REED DR
TWILIGHT TRL
CAROWELL LN
HIGHWOOD DR
EVERGREEN RD
ADAMS LN
GREEN WILSON RD
IRON DR
US HIGHWAY 127 S
MILLS LN
WASH RD
ERIN WAY
NINEVAH RD
RIVER VALLEY RD
OLD LAWRENCEBURG RD
BIG EDDY RD
GLENNS CREEK RD
COFFEE TREE RD
ATHLETIC DR
EWING ST
SHELBY ST
MURRAY ST
E MAIN ST
REILLY RD
HOLMES ST
WILKINSON BLVD
LYONS DR
COUNTRY LN
SARATOGA
VERSAILLES RD
HANLY LN
LEESTOWN RD
S SCRUGGS LN
DUNCAN RD
I-64
I-64 NC
SCHENKEL LN
CHINOOK TRL
GEORGETOWN RD
STONEHEDGE
SWITZER RD
REDDING RD
LUCAS LN
COLSTON LN
PEARS MILL RD
HOLT LN
US HIGHWAY 127 N
CK FERRY RD
Legend
FranklinCenterlinesFrom_KYTC
CityBoundary_0216
frankfort ua
franklincounty
N
W
E
S